

Pathfinders in Medicine

Victor Robinson

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Pathfinders in Medicine



THE SEMMELWEIS MONUMENT - BUDAPEST

PAINTED FOR
"PATHFINDERS OF MEDICINE."

Pathfinders in Medicine

By
Victor Robinson

With a Letter from Ernst Haeckel
and an
Introduction by Abraham Jacobi



New York
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1912

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BY MEDICAL REVIEW OF REVIEWS

To Ernst Haeckel

Illustrious Master:

It is with pleasure that I avail myself of your permission to dedicate my book to you. Not only the young men of Jena are your pupils; wherever is found a truth-seeker, there is found a student of Haeckel.

The world knows that on the battlefield of rationalism, you are the leading warrior. In the struggle for truth, your voice has long been the foremost. In the conflict against superstition, you have ever held aloft the banner on which is inscribed *Impavidi progrediamur!* The history of modern science cannot be written without the name of Ernst Haeckel.

Nothing unworthy must be found in these pages; no unfair passage should be left within these covers; only pure thoughts belong to a book consecrated to an unsullied light-bringer. I have written with careful hands and clean; for I have sat near the altar of the Temple of Truth. The many shortcomings and imperfections of this volume are due to my limitations alone; the best that I could do, I have done.

Our benefactors are those who enlarge our mental vision; since Darwin and Spencer left us, you have remained without a peer in the realm of thought — and you have gone beyond them. Nothing can repay my intellectual debt to you, but as a token of my endless esteem and affection, I lay before you my *PATHFINDERS IN MEDICINE*.

VICTOR ROBINSON.

Dr. Victor Robinson, New York.

Genae 30. 3. 1912.

Lieber und hochgeachteter Herr Doctor!

Für Ihre freundliche Intention, mir
Ihr Werk über „Pathfinders in Medicine“
zu dedicieren, sage ich Ihnen meinen
hervorgehobenen Dank! Wenn ich diese
hohe Distinction in Bescheidenheit
annehme, kann ich es nur damit
rechtfertigen, dass ich seit 60 Jahren
emstlich bestrebt war, die Erkenntnis
der Wahrheit in der Medizin zu
fördern, und die feste Grundlage dafür
im Aufbau der Anthropogenie zu schaffen.
Mit der Bitte, mir Ihre freundliche
Gesinnung auch fernwärts zu bewahren,
bleibe ich hochachtungsvoll

Ihr ergebener Ernst Haeckel.

AUTHOR'S NOTE

Three years ago, when the first of these sketches appeared, I did not expect to write enough of them to make a book. I entered the field of medical history as I had entered several others — out of curiosity. But the fruit was tempting, and I have gathered it ever since.

At the beginning of this year, when the *Medical Review of Reviews* came under its present management, I assumed the editorship of the Department of History of Medicine, and it is for this journal that most of these *Pathfinders* were originally prepared. Some of them, however, had previously appeared in the *Medical Record*, *American Journal of Clinical Medicine*, and the *Critic and Guide*, to which periodicals my thanks are due for permission to reprint.

After a few of these essays had been published, some physicians wrote and spoke to me of the desirability of continuing the work and collecting it in a volume. Altho we are supposed to have a psychological prejudice against taking advice, I regarded this proposition with favor. I am glad to say that among the physicians who made the suggestion to me, was the Nestor of American Medicine, Professor Abraham Jacobi. Dr Jacobi has likewise been generous enough to write the Introduction. He himself is thoroly versed in the history of medicine, as can be seen by consulting the eight excellent volumes of 'COLLECTANEA JACOBI.'

In my opinion the doctrine of evolution has done more for the intellectual uplift of the human race than all other movements combined. Its chief pioneers were Darwin, Huxley, Spencer, Tyndall, Wallace, Haeckel. Out of this group only Wallace and Haeckel survive. Wallace, unfortunately, has gone over to the enemy — he has become a spiritualist; there

remains to us, therefore, only Professor Haeckel, the boldest and most effective fighter of them all, and no incident connected with the making of my book has given me quite so much gratification as his willingness to receive the dedication.

I desire to express my thanks to Dr Eva Helen Knight for her kindness in performing an arduous task—reading the proofs of this volume. Sometimes I think it is easier to write a book than afterwards to wrestle with the printer's proof.

V. R.

New York, August 16, 1912.

INTRODUCTION

THE question whether it is history that makes men, or men that make history, has often been raised, but has never been answered to everyone's satisfaction. In most of the histories of nations that repose in our libraries, ample credit is given to warriors and kings and destroyers. But the slowly developing culture of the masses, not sung in epics, does not come in for its share of appreciation any more than the multitude of drops which hollow the rock. Still it is the quiet work of eras extending over tens of thousands of years that has brought about advancement without abrupt jumps.

Our experience is quite different in connection with arts and sciences, for in arts and sciences it is individual brains and exertions that have created sudden wonders which caused permanent changes in knowledge and convictions, and resulted in practical reforms and revolutions.

In America the history of medicine is almost never taught, and as long as our universities do not teach it, the pupils feel encouraged to neglect it.

We have no journal devoted to the history of medicine^{*}, and our books on the subject are few, and are not on as many shelves as they should be—or are shelved too soon. We have only John Watson's *The Medical Profession in Ancient Times*; *The Nose and Throat in Medical History* by Jonathan Wright; Alvin A. Hubbells' *The Development of Ophthalmology in America*; Samuel D. Gross' *Lives of Eminent American Physicians and Surgeons*; *A Century of American Medicine* by Clarke, Bigelow, Gross, Thomas and Billings; the valuable works of Packard and Mumford, and a very few others.

To this list of works on medical history has now been

added Victor Robinson's *PATHFINDERS IN MEDICINE*. The tales of men who were epoch-makers have been collected in the fifteen essays of this book. Their names have all become historical, and are immortal. That one of them should have been burned, and one driven insane, and several others abused and reviled, proves only their power to stir the passions of existing ignorance, and thru their martyrdom to initiate new eras.

I deem it a privilege to have read these essays before they were printed in this shape. I consider it an honor to be permitted to preface this book which will prove a source of instruction and edification both to the profession and the public at large. The author's facts as related are absolutely correct, and the warm-hearted sympathy with which the reports of bygone times and men are drawn up, will arouse the reader's enthusiasm and gratitude.

New York.

a Jawah

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(130-200 A. D.)

GALEN AND GREEK MEDICINE

GALEN AND GREEK MEDICINE

I have long since finished, divine Cæsar, the abridgement of the books of Galen, which you charged me to make, during our residence in the nearer Gaul. You deigned to express your satisfaction on the subject, and you enjoined upon me, at the same time, another work—that of reducing to a single volume, all that the most illustrious physicians have taught, of utility, on the Healing Art. I have, therefore, resolved to gratify you according to my abilities. I shall be careful to omit nothing of what Galen has said, because he is, of all those who have written on these matters, the one who has treated his subjects with most clearness, reason, and method. Moreover he shows himself the faithful interpreter of the principles and sentiments of Hippocrates.

ORIBASIVS: *to Julian the Apostate.*

WE may judge a man by the company he keeps, by the books he reads, perhaps even by the clothes he wears, but not by the woman he marries. Take Nikon, for instance: a quiet man, a mathematician and a philosopher, asking for nothing but to be left in peace among his parchments—but what a wife he had! Such a bawling virago, biting her maids and tormenting her husband, that all who saw her declared Xantippe a paragon of patience by comparison. And Xantippe had reason for her lip-labor, because Socrates made no money, while Nikon was a wealthy man.

But Nikon had one consolation: his son, Claudius Galenus. It is true, at times the lad exhibited a hasty temper, but above all he was studious. Galen hated his noisy mother, but loved his thoughtful father. Nikon fed the boy on a stimulating diet that has never been equaled: Greek philosophy. Geologists tell us that the earth has cooled—so has the human mind. The ancient Greeks will forever remain the intellectual wonders of the world. It was not sufficient to tell young Epicurus that all things came from Chaos, for he then asked, 'And whence came Chaos?' When a Greek philosopher gazed at the sea or the sky, he uttered epigrams which

will be repeated by the lips of time till the waters go dry and the firmament passes away.

By the time Galen was seventeen years of age he knew the stoic, platonic, peripatetic and epicurean systems, and had already composed a commentary on the dialectics of Chrysippus; he resolved to consecrate himself to the pursuit of knowledge, and when he read how a citizen of Megara risked his life in order to listen to Sacrates, he hoped that some day he too would be able to sacrifice something for the sake of philosophy, or at least be able to exclaim with Anaxagoras, 'To philosophy I owe my worldly ruin, and my soul's prosperity.'

But one night Æsculapius appeared to Nikon and warned him that his son must devote himself to medicine. It seems that a mathematician may be a mystic, for Nikon believed in dreams; the son likewise accepted the omen, and henceforth Hippocrates meant even more to him than Plato; Claudius Galenus thus fulfilled Aristotle's maxim, 'The philosopher should end with medicine—the physician commence with philosophy.'

In Pergamus, Asia Minor, where the family of Nikon lived, was a school of medicine, and a library that made Alexandria envious. Indeed, the second Ptolemy was ignoble enough to decree that no more papyrus should be exported from Egypt in order to keep Pergamus from adding more manuscripts to its archives, but the Pergamene people took splendid revenge by inventing parchment.

But Pergamus was chiefly celebrated for its shrine to the healing god. According to Lucian, Jupiter was complaining that his altars were deserted since Apollo set up his oracle at Delphi, and Æsculapius opened shop at Pergamus. At Epidarus and Cos the Asklepiions were equally successful—in spite of the satires of Aristophanes. Always craftier than the populace, the priests built the temples of Æsculapius in spots favored by nature—in the midst of a health-giving forest, by the side of a medicinal spring, on the brow of a lofty hill. The sight alone often served to bring the first smile of hope to the

weary invalid — and patients who seemed too sick were not permitted to approach the sacred precincts. All the glories of Greek art were there — lovely Venus and laughing Bacchus, Zeus serene on his golden throne, and Æsculapius sorrowing for the ills of mankind. Fountains played in the shaded groves, and shelter-seats were arranged in semi-circles of pure marble. And when hidden music floated over the southern flowers — the mingling of rhythm and perfume, the marriage of fragrance and melody — many sufferers raised their heads to repeat the prophecy of the Delphic sibyl: Oh, Æsculapius, thou art born to be the world's great joy.

Only after he had undergone a course in dietetics and hygiene, did the gates of the temple open for the pilgrim; but that night he lay at the foot of the statue of Æsculapius, awaiting and expecting a cure. At times, when the snores of the patient were echoed back by the marble walls, the priests would steal noiselessly forth and bind a broken limb or anoint a wounded organ. Of course every temple rang with tales of wonderful cures. Who ever heard of a shrine — tho it be built above the bones of an ass — that did not report miracles, and exhibit abandoned crutches and votive offerings as proof? A mortal like Socrates refused remuneration for his teachings, but Æsculapius demanded silver and gold for his services — at least so the priests claimed. Indeed, on one occasion, the god so far forgot himself as to say aloud to a patient, 'Thou art healed, now pay the fee.'

But an Asklepiion afforded excellent opportunities to the right man, and during an epidemic of carbuncles, when ulceration laid bare the structures beneath, Galen studied anatomy. But what did this intelligent and well-trained youth think of the wonder-tales of divine cures which were bruited about? He believed these stories implicitly, for credulity, like tuberculosis, is universal.

In his twentieth year Galen learnt the limits of the physicians' power: they could not save his father. He then left Pergamus, to pursue his studies in various cities, for the

conquests of Alexander had dispersed Greek culture far and wide. Galen journeyed to Smyrna, where he became a pupil of Pelops, who was an authority on muscles; at Corinth he studied under the anatomist Numisianus; he traveled thru Asia Minor and Palestine, everywhere absorbing knowledge and performing autopsies with enthusiasm.

But Alexandria called to him; in those days the Hellenic capital of Egypt was the chief seat of Hellenic learning; the seeds from the tree of Hippocratism had fallen and blossomed in Pharaoh's land. In Alexandria Galen found himself engulfed in a vortex; all currents of medical thought circled around and whirled on into the eddy of dialectic subtlety; dozens of sects argued violently; all schools pressed their claims in eloquent debate: dogmatists, methodists, pneumatists, eclectics. Some swore by Hippocrates; others by Herophilus; others by Erasistratus; Diocles, Praxagoras, Callimachus, Dioscorides, all had their adherents. Clinical observations were neglected for experiments in rhetoric; it was enough to make one think of the tombstone-epitaph that Pliny loved to quote: 'He died by reason of the confusion of the doctors.'

Galen was not the man to allow himself to be long perplexed by the wrangling of rival physicians. Physically buoyant and healthy, gifted with genius, contemptuous of others and with boundless confidence in himself, he selected from each sect what appealed to him, rejected the rest, and built up a system of his own. Fortunately he was wise enough to take as his model the incomparable Hippocrates. Galen's ability was vast and his industry unwearied; he soon learnt all that teachers could impart. Before he completed his teens he began to write on medical topics, and during his journeys treatise after treatise fell from his prolific pen. Galen was absent from his native place for nine years; at about the age of twenty-eight he returned, and the bronzed and cultured traveler was welcomed by the high priest of Pergamus who appointed him physician to the gladiators.

The occurrence of the gladiatorial combats was evidence that Hellas had fallen: the stern games in which strong men hewed each other with spears; the bloody battles by torchlight; the strange animals, captured from African forests, charging against their tormentors; the fantastic fighting between dwarfs and women; the whole excited assembly rising and shouting as rivers of blood flowed thru arena and amphitheater; pain and fear below, and lust and luxury above,—*Ave, Cæsar; morituri te salutant!*—in this manner the Romans, but not the Greeks, amused themselves.

For four years Galen tended the wounded gladiators; in this employment he acquired an extensive knowledge of surgery, and his methods of treatment proved unusually successful. But Galen was not content with Pergamus; he wanted Rome. A province in lesser Asia was insufficient for a medicus who felt himself greater than all other physicians; as well have expected Aristotle — Nature's private secretary, as Eusebius called him — to hide his talents at Stagira. To show off his superior attainments, Claudius Galenus needed the center of the world's stage; aware of his power, and consumed with ambition, he hungered and thirsted for the streets of the wicked but mighty capital.

Rome, the great plagiarist, never had a medicine of her own. Rome was notorious for her hatred of doctors. Pliny, author of the dictum that a doctor is the only person not punished for murder, has left it on record that for six hundred years the Romans knew no physicians. But gradually Greek physicians settled in Rome, and the men of Mars seemed to grow accustomed to the extravagance. But the tradition remained, and Pliny wrote, 'The dignity of the Roman does not permit him to make a profession of medicine, and the few Romans who begin to study it are venal renegades to the Greeks.' Pliny's contemporary, Valerius Martial, composed medical epigrams for the delight of his sturdy countryman:

Languid I lay, and thou camest O Symmachus, quickly to see me;
Quickly thou camest and with thee a hundred medical students;

The hundred pawed me all over with hands congealed by the north wind; Ague before I had none, but now, by Apollo, I have it!

In the year 162 a stranger entered Rome — it was Galen. In the midst of the barbers, bath-keepers, midwives, magicians, plaster-spreaders, ointment-makers, bleeders, cuppers, abortionists, makers of love-philters, venders of amulets, had come a disciple of Hippocrates. Specialism was rife in Rome, as we learn from Martial's irony: 'Cascellius extracts and repairs bad teeth; you, Hyginus, cauterise ingrowing eyelashes; Fannius cures a relaxed uvula without cutting; Eros removes brand-marks from slaves; Hermes is a very Podalirius for ruptures.'

But Galen was a specialist in all branches, and panted only for an opportunity to diagnose the disease of a senator or prætor — and thus win fame and fortune at a stroke. Among his first patients was Eudemus, a peripatetic philosopher of renown. The wife of the consul Bœthus was sick; Galen cured her, and received the consul's friendship, four hundred gold pieces, and a reputation. A noble Roman matron, the wife of Justus, could not sleep; her case baffled all the physicians; but Galen traced her insomnia to her love for the dancer Pylades.

Galen did not make diagnoses merely by feeling the pulse; he studied not only the disease, but the patient, and he took considerable pleasure in proclaiming that much of his success was due to his ability to take advantage of an opportunity: he would observe what was in a vessel that a servant was carrying out, or what was contained in the jar that stood near the invalid. Evidently he was the spiritual ancestor of that physician who berated his patient for eating horse-flesh, and when questioned by his assistant how he knew this to be the case, answered, 'I saw the harness under the bed.'

It was not long before Galen became the most distinguished practitioner in Rome. He was called the wonder-worker — Paradoxopœus. Galen did not accept the title with blushing cheek and downcast eye. The conceit which enabled him

to say, 'Whoever seeks fame need only become familiar with all that I have achieved,' was thick enough to protect him from embarrassment at any compliment. Not only did the boastful Galen praise himself unceasingly, but he mocked all his rivals with a scornful tongue; he called them fools and asses, and told them they did not know anything.

'I have done as much to medicine,' wrote Galen, 'as Trajan did to the Roman Empire, in making bridges and roads throughout Italy. It is I alone that have pointed out the true method of treating diseases: it must be confessed, that Hippocrates had already chalked out the same road, but as the first discoverer, he has not gone so far as we could wish; his writings are defective in order, in the necessary distinctions; his knowledge in some subjects is not sufficiently extensive; he is often obscure after the manner of the ancients, in order to be concise; he opened the road, but I have rendered it passable.' Some figures of antiquity appear hardly human: the white-robed Plato, broad of brow and ever-thoughtful, slowly pacing down the shadeful aisles of the Academic Grove, seems more like a personification of philosophy than a man, but Claudius Galenus had qualities like our next-door neighbors.

The leaders of Roman society requested Galen to establish a course of lectures on Anatomy and Physiology, which he gladly did, illustrating them with experiments on goats and pigs. The élite crowded to these demonstrations, and were pleased to be informed that they possessed more common sense than the physicians.

At Alexandria Galen had been fortunate enough to witness two human skeletons, and he strongly urged all who intended to study osteology to go to Africa. But at his lectures a human skeleton was never exhibited, for the good reason that there was not a single one in all Rome. So bloodthirsty were the Romans of this period, that neither the populace nor the fashionables could enjoy a holiday unless contending ranks of gladiators were butchered for their sport, but they recoiled with horror at the notion of permitting a scientist to examine

the murdered corpse. In this respect the Romans resembled a small and persecuted sect — despised by Galen — which was just rising into prominence at this time, but which was later to overrun all Europe and forbid dissection on the ground that it was impious to mutilate the image of God, and yet showed no hesitancy in crushing the bones or burning the bodies of thousands of heretics. The psychology of inconsistency is tragically interesting.

For four years Galen resided at Rome, writing many of the works which have perpetuated his name: he worked as hard as he bragged. ‘There are many physicians,’ declared Galen, ‘like the athletes, who would like to win prizes in the Olympic games, and yet will not take the pains necessary to gain them. For they are loud in their praises of Hippocrates, and place him in the highest rank among physicians; yet never think of imitating him themselves. It is certainly no small advantage on our side to live at the present day, and to have received from our ancestors the arts already brought to such a degree of perfection; and it would seem an easy thing for us, after learning in a short time everything that Hippocrates discovered by many years of labor, to employ the rest of our lives in investigating what still remains unknown.’

In the year 166 it was practically certain that he was to be admitted into the imperial court. Yet it was at this very time that he secretly left the capital. Galen claimed he so acted because he feared his envious rivals had decided to assassinate him. But the truth seems to be that he left Rome because an epidemic had come. Rome, with its usual intrigues, was bad enough; but Rome, with an eastern pestilence added, was too much for the Pergamene physician. Galen was too selfish to die for others. In those days there were real plagues: this one spread over Europe, infected everything in its wide path, and remained for fifteen years, slaughtering men and animals by the million, terrorizing the world into a mad-house and a morgue. Æsculapius must have been sleeping.

Galen set his face toward home, studying all the way; from

the copper mines of Cyprus he collected medicinal ores, Balm of Gilead at Palestine, asphalt from the Dead Sea, and many drugs in Phœnicia. At last he stood once more in the fertile valley of Pergamus; he remained there about a year. But the Greeks and Romans had a habit of recalling their famous sons almost as soon as they were out of sight. Half the illustrious men of Athens and Rome were exiled and invited to return. The emperor Marcus Aurelius summoned Galen to his side. Marcus Aurelius was at Aquileia, preparing to wage war against the Marcomanni, tho he would much have preferred to be in his study, writing his *Meditations*. When Galen arrived in the camp, the flesh-fed plague was thinning the army, and the emperor and his soldiers fled back to Rome. On setting out a second time against the enemy, Marcus Aurelius desired Galen to be his companion, but the physician informed his ruler that in a dream Æsculapius had warned him to remain at Rome and attend the emperor's children. And sure enough, little Commodus soon became sick, and Galen performed the doubtful service of saving a creature that became one of the most infamous of the hideous Roman emperors. But Faustina, the mother of the monster, was pleased, and she thanked Galen heartily, and crooned into the ear of her child that one day he would wear the purple.

Upon the decease of Demetrius, Galen was appointed court physician, but he had considerable time for scientific work, as his chief duty consisted in preparing for Marcus Aurelius a costly treacle, a supposed antidote against all poisons. In the days of imperial Rome such precautions were not superfluous, but what the mixture really contained we cannot say, as its principal constituents were immersed in a flood of polypharmacy.

In 175 Marcus Aurelius succeeded in subduing the fierce Marcomanni, and returned to the capital. Of course a triumphant emperor must be feasted, and the Romans were champion gluttons with extraordinary alimentary canals, but the scholarly Aurelius was really a transplanted Greek whose or-

dinary stomach gave way under the endless courses. Poor Marcus needed all his stoic philosophy to keep him from groaning, and he sent for several physicians. A physician's function is to administer medicines, and they did so, but their drugs did not avail. Galen was sent for, but we must allow him to relate the incident in his characteristic style:

'Hereupon I was summoned also to spend the night in the palace, a messenger coming to fetch me, by order of the emperor, just as the lamps were being lighted. Three physicians had seen him in the morning and at the eighth hour, and two had felt his pulse, whilst to all did it appear the beginning of an attack. I, however, remained silent; then the emperor, perceiving me, asked why I had not, like the others, felt his pulse. I replied: Two have already done this, and from their experience upon the journey with thee are better able to judge of its present condition. As I said this he called on me to feel him, and as the pulse, taking into consideration the age and constitution of the patient, seemed to me inconsistent with an attack of fever, I declared that none was to be feared, but that the stomach was overloaded with nourishment which had been coated with phlegm. This diagnosis called forth his praise and he thrice repeated: Yes, that is it, it is exactly as thou sayest; I feel that cold food is disagreeing with me. He then asked me what was to be done. I answered him frankly that if another than he had been the patient, I should, following my custom, have given him wine with pepper. With sovereigns like thyself, however, I said, physicians are in the habit of employing the least drastic remedies, therefore it must suffice to apply wool saturated with warm spikenard upon the abdomen. The emperor replied that warm ointment on purple wool was his usual remedy for pain in the stomach, and called Peitholaus to apply it while he bade me depart. No sooner had I gone than he demanded Sabine wine, threw pepper into it and drank, after which he said to Peitholaus that now at last he had a physician and a courageous one, repeating that he had tried many but that I was the first



GALEN

of physicians and the only philosopher amongst them.'

Of all the old dietitians, and it must be remembered that the ancient physicians paid much attention to food,—Athenæus being enthusiastic enough to remark that a good physician ought to be a good cook,—Galen was by far the greatest. There is indeed little in the realm of dietetics, from pistachio nuts to the flesh of buck-goats, that was not considered by him; and the diet fitting to the different seasons, the diet of persons actively employed, the diet of travelers, the regimen for infants and for the aged, repletion and easy methods to produce vomiting, are only a few of the dietetical topics which he discussed sagaciously. Of course he gave directions for reducing obesity, but if he had any success in this respect, he knew an elegant art that is lost to the moderns.

He stood high as an hygienist; he was the man to consult on questions of baths and gymnastics; his work among the gladiators made him a leading authority on exercise. He was the founder of climatic cures, and ever since then, wealthy women have been asking, 'Doctor, what disease must I have in order to go to Ostend?'

On fevers, and everything connected with febrile affections, whether ephemeral, bilious, putrid, hectic, tertian, quattran or quotidian, Galen was the chief fountain-head of wisdom. Regarding the plague, however, he had little to say; perhaps his conscience was pricked, for he had only to open Thucydides to see how Grecian physicians perished at their posts during the epidemic at Athens.

Such homely subjects as corns and callouses, burns and blisters, coughing and sneezing, a bruised nail, headache, toothache, baldness, bleeding of the nose, loss of eyelashes, wrinkles and freckles, Galen treated with sense and skill. He wrote good descriptions of jaundice, colic, dropsy, asthma, coryza, dysentery; and on such diverse maladies as diseases of the teeth, ulcers, wounds of nerves, scirrhus, herpes, gangrene, erysipelas and emphysema, he was the chief authority of classic antiquity.

As far as we know he was the only one of the ancients who wrote a treatise on feigned diseases; he was the first to treat of aneurism; he wrote seventeen chapters on the pulse; he was the first who realized the importance of predisposition to disease; he based his prognosis upon diagnosis; he paid much attention to secretions and excretions; it is claimed that his ophthalmic collyria could be consulted with advantage by present-day oculists; he knew that phthisis was infectious, saying, 'It is a matter of experience that those who sleep in the same bed with consumptives fall into consumption, also those who live long with them, eat and drink with them, or wear their clothes and linen.'

In obstetrics Galen did not distinguish himself; the great obstetrician and gynecologist of antiquity was Soranus of Ephesus. Galen spoke of two uterine cavities, the right for the male fetus, and the left for the female,— which causes us to suspect that he never examined a woman's womb. Galen, however, did make some meritorious investigations into the causes of sterility. As a surgeon, Galen did not equal his contemporary, Antyllus.

As a writer on *Materia Medica* he cannot rank with Dioscorides, but he was second to him alone. It has been calculated that Galen's *Materia Medica* consisted of 540 plants, 180 animal, and 100 mineral substances.

He was a prolific writer on pharmacy; he wrote so much about plasters that if he had been an ordinary worker he would not have had time for anything else. The preparation of medicines by physical means is still called galenical pharmacy, but it is not clear why he has been honored with the title of Father of Pharmacy.

Reaching the outposts of the knowledge of Herophilus and Erasistratus, and advancing indisputably beyond them, Galen stood without a rival as an anatomist. He was practically the creator of morphology, and it must be remembered that unlike the older Alexandrian masters, he had no opportunity to explore the human body; his scalpel was confined chiefly

to apes, but he used all animals he could obtain, from elephants to mice. The Father of Anatomy never dissected a man. Galen must have been seized with envy when he read in Celsus that in the days of the Ptolemies not only did the Alexandrian scientists have all the corpses they needed, but that they received criminals 'for dissection alive, and contemplated, even while they breathed, those parts which nature had before concealed.'

To-day, whoever speaks of anatomy, pays tribute to Galen; the *platysma myoides*, says the modern anatomist, but this muscle was first named and described by the Pergamene physician. The frontalis muscle, the popliteus, the two muscles of the eyelids, the six muscles of the eyeball, the muscles of the spine, the muscles of each lateral cartilage of the nose, the maxillary group of muscles, with many muscles of the head and neck, both extremities and the body proper, were comprised in the Galenian myology, and in many instances the names which he suggested have been retained unto the present time.

He divided the vertebrae into cervical, dorsal and lumbar, and gave a correct account of the number and situation of each. He named the bones and sutures of the cranium, and knew the squamous, styloid, mastoid and petrous portions of the temporal bones; the sphenoid, the ethmoid, the malar, the maxillary and nasal bones were familiar to him. In these descriptions Galen made few errors. The moderns have made little change in his osteology.

Angiology was the weakest point in the Galenic structure of anatomy, but even here he built better than his contemporaries, for in opposition to the prevailing views of the age, he proved that the arteries convey, not air, but blood. He was the first to describe, with some correctness, the aorta, the jugular vein, and the three coats of arteries. We are not in the habit of thinking that the capillary connection between the arteries and veins was known in antiquity, but let us not be startled at anything that we find among the Greeks: Hippoc-

rates used the word circulation, and Galen knew anastomosis. In *De Usu Partium* Galen wrote: 'The arteries and veins anastomose with each other thruout the whole body, and exchange with each other blood and spirits by certain invisible and exceedingly minute passages.'

Galen's contributions to neurology were noteworthy. He knew that the brain is the central organ of the nervous system, and that the spinal cord is an offshoot, but he made the mistake of thinking that the nerves of sensation arise in the former, and the nerves of motion originate in the latter. His method of demonstrating the brain was a masterpiece of minuteness, and he traced several of the cranial and spinal nerves with accuracy. 'If the spinal cord,' wrote Galen, 'be divided lengthwise from above downward by a straight section thru the median line, none of the nerves going to the intercostal muscles are paralyzed, either on one side or the other, nor any of those going to the loins or the lower limbs.' We agree with him that the motor fibers do not cross the cord, but we wait to hear what he will say as to the effect on sensibility, but he was silent, and seventeen centuries passed before the answer came that a longitudinal section of the cord in the median line, while it does not interfere with motion, destroys sensibility. The nervous system was his favorite field of investigation, and the fruit was rich enough for him to earn the title of Founder of Experimental Physiology.

His description of the thoracic contents is good,—except that he thinks the heart is not a muscle because it acts continuously, while all muscles alternate their work with rest,—and his account of the abdominal organs and the urinary apparatus was explicit and precise.

We have yet to mention that he discovered or was the first to describe the tendon Achilles, the lachrymal ducts and glands, the ductus Botalli, foramen ovale, the corpus callosum, septum lucidum, corpora quadrigemina.

Galen was an explorer, but the lands that lie beyond the seas did not interest him like the unknown regions of the

body; he did not crave to discover distant kingdoms, for locked within the cranium he found ample treasures; he blazed no path in primitive forests, but all thru its winding labyrinths he followed the trigeminal nerve, slowly discovering the secrets that were strewn along its tortuous way. Galen adored the mechanism of the body; he was filled with wonder at the perfection of its parts. He claimed that in writing anatomy he was really celebrating the Creator; again and again the great Pagan physician breaks forth into pæans of praise: 'In writing these books I compose a true and real hymn to that awful Being who made us all; and, in my opinion, true religion consists not so much in costly sacrifices and fragrant perfumes offered upon his altars, as a thoro conviction of his unerring wisdom, his resistless power, and his all diffusive goodness.'

An extract like the following illustrates Galen's interest and delight in the body: 'In the inner cavity of the larynx there is a structure of peculiar formation, which we have already shown to be the principal organ of the voice. It resembles the mouthpiece of a reed-pipe, especially when seen either from above or from below. Instead, however, of comparing the glottis with the tongue of reed instruments, it would be more appropriate to compare them with the glottis. For the works of Nature are both earlier in time, and more perfect in construction, than those of art; and, as the glottis is the work of Nature, while the reed-pipe is the production of art, it is possible that the latter might have been made in imitation of the glottis by some clever artist, able to understand and copy the structure of natural objects.'

His teleological proclivities are seen in passages such as these: 'In my view there is nothing in the body useless or inactive; but all parts are arranged to perform their offices together, and have been endowed by the Creator with specific powers.'

We regret that we cannot share Galen's convictions in these respects. Man is compelled to perform the lowest and highest functions in life with the same organ, and was it nice on

Nature's part to place the womb between the bladder and the rectum? St Augustine was no physiologist, but he was vilely correct when he said that we are born between urine and feces.

Teleology was indeed a rotten spot in Galenism. Wise Anaxagoras had said that adaptation to function disproves teleology, but Plato and Aristotle believed in design in nature, and Galen followed them, and erected the most elaborate teleological system ever known. Hippocrates approached questions with an open mind, but Galen came with his dogmas, and sought to make his observations fit into the mold of pre-conceived notions. His practical work was invaluable, but most of his theoretical digressions are tedious and worthless. He wrote volumes of nonsensical assumptions, and seemed to suffer from an Asiatic imagination. It often happened that he was prevented from interpreting his results correctly because of his predilection for *a priori* reasoning.

Hippocrates left medicine free, but Galen fettered it with hypotheses. Hippocrates related his failures, and used to say, 'I do not know,' but Galen always imitated an oracle. 'Science and Faith,' said Hippocrates, 'are two things: the first begets knowledge, the second ignorance;' but Galen sought to mix the observations of Hippocrates with the metaphysics of Plato. Galen abhorred doubt; his mind craved for finalities. Galen admired Euclid's method of proving things, and he tried to make medicine as exact a science as geometry; it is difficult to decide which was the greater — the absurdity or the audacity of the attempt. In his system everything was explained; everything was catalogued and tabulated. He answered all questions, he solved all problems. There seemed nothing left for others to do except to say, Amen. And so it was. Galen was the last of the Greeks, and when he spoke no more, the voice of antiquity was hushed.

Already in the second century there were signs of the coming darkness; soon the imperial city succumbed to invading barbarians, and in the ashes of Rome was buried all that was left of Greece. Then came the deluge. Clouded by Chris-

tianity, the world lay for centuries in the abyss of irrationalism. Monks crept over Europe, and in their trail walked mental stagnation. Medicine became magic, and science was turned into sorcery. Supernaturalism displaced the natural, and no fact was believed unless it was supported by a miracle. Sometimes a Jewish or Arabian physician would stir a smouldering Greek ember into flame, but it was intellectual night in the dominions of the Nazarene.

During the fifteen hundred years that the world was too indolent to think for itself, Galen was its undisputed authority. His dogmatism was well suited for the general sloth. He was regarded as infallible; age after age rolled by, and in Europe, Africa and Asia he remained the unquestioned dictator. From his grave he ruled continents and centuries. He had only one rival — the Stagyrte. 'If Galen and Aristotle are of one mind on a subject,' wrote Rhazes, 'then of course their opinion is true. When they differ, however, it is extremely difficult to decide which opinion to accept.' So we see that the scholars of the Dark Ages followed Galen and Aristotle blindly, and never caught the Greek spirit of free inquiry.

Light did not shine on earth again, until the passion for Greece so inflamed the hearts of men, that on the abandoned altars of Hellas, awakening Europe found burning the torch of unfettered speculation. This was the death-knell of the Dark Ages, and when the clarion calls of Doubt went ringing thruout the lands, medievalism was transformed into modernity; there was a new dispensation, and new reckonings and re-adjustments. It was a Revolution that mankind has termed the Renaissance. Truth was once more saluted, and in the re-birth of the intellect, independent thought again came to human brains. What happened in art and literature and in general science, is common knowledge and is taught to every school-child, but medical science likewise had its resurrection. A young Flemish anatomist, who plied his scalpel enthusiastically, declared that Galen had made mistakes. The

old generation was aghast at the blasphemy, but the world was marching on, and from his inviolate throne, at last fell the physician of Pergamus. But his worth was measured in the impartial balance of history, and the verdict was that Galen was the Prince of Physicians — but not infallible.

ARETÆUS, THE FORGOTTEN PHYSICIAN

ARETÆUS, THE FORGOTTEN PHYSICIAN

Whatever the final judgment may be, one thing stands out as certain —after Hippocrates, no single Greek author has equaled Aretæus, and no work in the entire literature so nearly approaches to the true spirit of Hippocratism, both in description of disease and in therapeutic principles, as the work of the Cappadocian.

NEUBURGER: *History of Medicine.*

Aretæus is one of the most original and eloquent writers of antiquity. Starting with a thoro acquaintance with the science of his day, taking Hippocrates as his model, and repudiating all futile speculations, he details the simple results of his own experience, in a systematic treatise of eight books on the history and treatment of acute and chronic diseases, and in a manner so striking and appropriate as rarely to have been excelled.

WATSON: *Ancient Medicine.*

‘WHO is Aretæus?’ asked a distinguished Professor of Johns Hopkins University, on seeing the Cappadocian’s name on a program.

This question could well echo answerless thruout the medical world until it reached a medical historian. For Aretæus is a forgotten physician. A name once high in medical annals has fallen low; a star which once shone next to Hippocrates, has lost its lustre. Who is Aretæus?

Hippocrates, Herophilus, Erasistratus, Galen, and other physicians of antiquity became authorities in the Middle Ages; during this long period, Aretæus was unknown, and his oblivion still survives.

It is difficult to mention a subject or author who is not indexed at the Astor Library, but Aretæus has not a single card. This means obscurity indeed.

Clio seems more solicitous of the destroyers, than of the healers, of men. We know when the Duke of Alva was born, and are not in doubt of the time of Attila’s death. But we do not know whether the discoverer of the pulmonary

circulation of the blood was born in 1509 or 1511; we are uncertain whether the father of modern surgery came into the world in 1510 or 1517; with regard to Paulus Ægineta, the guesses are wider: Le Clerc says he belongs to the fourth century; Vander Linden says he was born in the fifth century; Sprengel says he lived in the seventh century; Vossius says nothing.

As far as Aretæus is concerned, there is a similar latitude of opinion: we have the consolation of knowing that he lived either in the first, second or third century. One reason for this uncertainty is that Aretæus quoted no author except Hippocrates; and no authors quoted him, except Aëtius and Paulus Ægineta, and as both of these writers lived considerably after the time of Aretæus, their reference to him furnishes no clew as to his period. He is also mentioned in the *Euporista*, formerly attributed to Dioscorides. If it were indeed the work of Dioscorides, it would practically solve the problem, as it is almost universally admitted that Dioscorides flourished in the first century. But it is now agreed that *Euporista* is not the composition of Dioscorides, but the work of a later age. According to some authors, the circumstance that neither Galen nor Aretæus mention each other, proves they were contemporaries.

There is even a conflict as to whether he belonged to the Pneumatic School, or the School of Eclectics, or any school at all. In truth, had he founded a school, let it be as irrational as Perkinism, his fame would be more secure.

It is quite certain that he lived in Alexandria, as he makes numerous references to the habits and therapeutics of the Egyptians; it is also probable that he resided in Italy, as he is familiar with the various brands of Italian wine: Fundan and Falernian, Signine and Surrentine. But all the biographic data that we know with certainty, can be expressed in one short sentence: Aretæus, a Greek physician of a Roman province in Asia Minor, described diseases in admirable Ionic.

As he is invariably called Aretæus the Cappadocian, we may say a word concerning this territory. In the time of Herodotus, Cappadocia occupied a considerable portion of Asia Minor, extending from Mount Taurus to the shores of the Euxine. It was originally an independent kingdom, but the Persians divided it into two satrapies, one of which became known as Pontus, while the inland province retained its name of Cappadocia. Now began sanguinary struggles, and there were endless intrigues, assassinations, murders, slaughters, cold-blooded cruelties without beginning or end. In the year 17 A. D. Cappadocia became a Roman province, grew and prospered, and produced St. Gregory the ecclesiastic who is still celebrated, and Aretæus the physician who is forgotten.

Some Greek seems to have had a prejudice against the province, for in the *Anthology* we find this couplet:

A viper bit a Cappadocian's hide;
But 'twas the viper, not the man, that died.

But tho the ever-falling dust of time has almost covered him over, it cannot make the name of Aretæus as if it had not been, for Aretæus has reared unto himself a monument more enduring than brass—what say you, Quintus Horatius Flaccus? His seven-arched structure was as follows:

Diseases
Therapeutics
Fevers
Surgery
Prophylaxis
Gynecology
Pharmacy

It is true the dome has fallen and the base has disappeared, but enough remains to demonstrate that Aretæus was one of the greatest of ancient physicians.

It is a delight to read Aretæus: he is not superstitious: his mind is not befuddled with outlandish theories: he is clear, rational and scientific; he does not indulge in any of those

mystical speculations which disfigure the pages of Paracelsus. Moreover he is a stylist. No doubt the strangest passage Aretæus ever wrote was his fantastic account of the uterus: 'In the middle of the flanks of women lies the womb, a female viscus, closely resembling an animal, for it is moved of itself hither and thither in the flanks, also upwards in a direct line to below the cartilage of the thorax; and also obliquely to the right or the left either to the liver or spleen; and it likewise is subject to prolapses downwards, and in a word, is altogether erratic. It delights in fragrant smells, and advances towards them; and, it has an aversion to fetid smells, and flees from them; and, on the whole the womb is like an animal within an animal.'

No medical author surpasses Aretæus in his vivid portrayal of disease. When he describes consumption, we must not read the symptoms twice to make a diagnosis. We hear the hoarse chronic cough, the clearing of the throat, the blood and pus spat up; we notice the sweats, the pallor, the cadaverous aspect; we see the bony fingers, the thickened joints, the curved nails, the sharp and slender nose, and the prominent Adam's apple; we see the narrow chest, the lips drawn over the teeth, the muscles of the arm gone, the ribs sticking thru the skin, the shoulder-blades projecting like wings of birds, and the eyes hollow and brilliant.

His descriptions of tetanus, epilepsy, hysteria and asthma have been especially praised, but his picture of Satyriasis is as powerful as any: 'Satyrs, priests of Bacchus, in the paintings and statues, have the phallus erect, as the symbol of the divine performance. It is also a form of disease, in which the patient has erection of the genital organ, the appellation of satyriasis being derived from its resemblance to the figure of the god. It is an unrestrainable impulse to connection; but neither are they at all relieved by these embraces, nor is the tentigo soothed by many and repeated acts of sexual intercourse. Spasms of all the nerves, and tension of all the tendons, groins, and perineum, inflammation and pain of the

genital parts, redness of countenance, and a dewy moisture. Wrapped up in silent sorrow, they are stupid, as if grievously afflicted with their calamity. But if the affection overcome the patient's sense of shame, he will lose all restraint of tongue as regards obscenity, and likewise all restraint in regard to the open performance of the act. Raving with his obscene imagination, he cannot contain himself; tormented with thirst, he vomits much phlegm, and the foam sits on his lips as in a lascivious goat, and he has a smell like that animal.' Strangely enough, the author of the above had no knowledge of nymphomania, and even denied its existence.

Among other disorders which he treats in an interesting manner are: migraine, jaundice, elephantiasis, leukorrhea, hemoptysis, pneumonia, diarrhoea, aortitis, cephalalgia, angina, dropsy, gonorrhea, dysentery, apoplexy, phrenitis, cachexia.

In his writings we find for the first time an account of diphtheria. The description is well-done except as to the etiology. There were giants in those days, but no compound microscopes, and Aretæus knew not the Klebs-Loeffler bacillus.

He is the first European who wrote a systematic account of diabetes. He correctly called it a species of dropsy, and paints with realistic strokes the patient's fiery thirst, his imperative desire to pass water, his dry mouth and parched skin; it is a wonderful malady, he says, a melting down of the flesh into urine.

According to Francis Adams — not the unhappy poet who sang the songs of the army of night, and slew himself in the morning of life — but the careful Greek and Latin scholar of the same name who was very familiar with the writings of the fathers of medicine, Aretæus was 'the first medical author who alludes to contagion in unequivocal terms.'

The fourth book of Paulus Ægineta begins as follows: 'Well, in my opinion, did Aretæus the Cappadocian say, that the power of remedies ought to be greater than those of diseases; and that for this reason elephantiasis is incurable, be-

cause it is impossible to find a medicine more powerful than it. For if cancer, which is, as it were, an elephantiasis in a particular part, is ranked among the incurable diseases by Hippocrates himself, how much more is not elephantiasis incurable, which is, as it were, a cancer of the whole body?’

Aretæus seems to have understood the direction of the blood-flow in the veins; if so, he knew more than the physicians of subsequent centuries. He was probably the first to use the trephine in epilepsy. He likewise had knowledge of tracheotomy. But his greatest claim to our consideration is his practice of auscultation. Dr Cordell, professor of the history of medicine in the University of Maryland, believes Aretæus is the only one of the ancient writers who auscultated the heart. René Laennac, inventor of the stethoscope, had a renowned forerunner.

He distinguished between the paralyses of motion and of sensation, and knew that injuries to the brain produce paralysis on the opposite side.

He divided mental disturbances into mania, melancholia, and settled insanity,—not a bad classification.

He described lead colic, and other disturbances due to lead poisoning. In obstruction of the urethra by vesical calculus, he employed the catheter. He removed stone by incising below the scrotum, and cutting inward to the neck of the bladder until there was an escape of urine and calculi. He deserves credit for his endeavors to found pathology upon an anatomical basis.

He had few queer notions. It is true, in conformity with the custom of his age, he was too fond of venesection, but he always warned against excess of bloodletting, claiming it was better to err on the side of chariness. He believed Castor was a remedy in all diseases of the nerves, and that White Hellebore would vanquish any case of gout. For this we must not blame him severely, for there is scarcely a physician who has not at least a couple old standbys by which he swears.

An idea of the nicety of his observations may be gained



ÆSCULAPIUS

from a random passage; in discussing methods for procuring sleep he writes: 'Gentle rubbing of the feet with oil, patting of the head, and particularly stroking of the temples and ears is an effectual means; for by the stroking of their ears and temples wild beasts are overcome, so as to cease from their anger and fury. But whatever is familiar to anyone is to him a provocative of sleep. Thus, to the sailor, repose in a boat, and being carried about on the sea, the sound of the beach, the murmur of the waves, the boom of the winds, and the scent of the sea and the ship. But to the musician the accustomed notes of his flute in stillness; or playing on the harp or lyre, or the exercise of musical children with song. To a teacher, intercourse with the tattle of children. Different persons are soothed to sleep by different means.'

Here is a bit of psychology which every medical man will endorse: 'This is a mighty wonder, that in hemorrhage from the lungs, which is particularly dangerous, patients do not despair, even when near their end. The insensibility of the lungs to pain appears to me to be the cause of this; for pain even when slight makes one fear death. In most cases pain is more dreadful than pernicious, whereas the absence of it, even in serious illness, is unaccompanied by fear of death and is more dangerous than dreadful.'

There is another sentence which we wish to quote, as it will arouse a response from every physician who has been called at the last moment or when there was no hope for recovery: 'If you give a medicine at the height of the dyspnea, or when death is at hand, you may be blamed for the patient's death by the vulgar.' What a world of reserve and dignity is in this simple remark! The shoulders of Aretæus the Cappadocian were broad enough to wear becomingly the mantle of Hippocrates.

Twenty centuries ago Aretæus knew the knack of driving a point home by a good story. Wishing to illustrate that the gout may intermit, he relates that a person subject to gout won the race in the Olympic games during the interval of

the disease. And he closes his chapter on melancholy thus: 'A story is told that a certain person, incurably affected, fell in love with a girl; and when the physicians could bring him no relief, love cured him. But I think that he was originally in love, and that he was dejected and spiritless from being unsuccessful with the girl, and appeared to the common people to be melancholic. He then did not know that it was love; but when he imparted the love to the girl, he ceased from his dejection, and dispelled his passion and sorrow; and with joy he awoke from his lowness of spirits, and he became restored to understanding, love being his physician.'

Aretæus shows himself a true physician by his concern and sympathy for the patient, in small matters and great: 'Inunctions are more agreeable and efficacious than fomentations; for an ointment does not run down and stain the bed clothes — a thing very disagreeable to the patient — but it adheres, and being by the heat of the body, is absorbed. Thus its effects are persistent, whereas liquid preparations run off.'

Elsewhere occurs this noble phrase, rarely equalled and never bettered: 'When he can render no further aid, the physician alone can still mourn as a man with his incurable patient: this is the physician's sad lot.'

Some authors call their work 'a confession'; this is unnecessary, as all writing is autobiographical. Write, and in spite of your best efforts at concealment, your feelings, passions, prejudices, your good qualities, failings, sympathies, will become apparent; where you least expect it, you will give yourself most away; your true self will lurk between the lines, and it will peep from the pages.

We are confident that from the excerpts here given, the reader has already formed a high opinion of Aretæus. If ever a man cast credit on the art of healing, it was the lofty-souled Cappadocian. He was a disciple who not only followed in the footsteps, but caught the spirit of the immortal Father of Medicine. Aretæus should not be a forgotten

physician, for no one better than he could repeat with decorum, the Hippocratic Oath:

‘With purity and with holiness I will pass my life and practise my art. Into whatever houses I enter, I will go into them for the benefit of the sick, and will abstain from every voluntary act of mischief and corruption; and, further, from the seduction of females and males, of freemen and slaves. Whatever, in connection with my professional practice, or not in connection with it, I see or hear, I will not divulge, as reckoning that all things should be kept secret. While I continue to keep this oath inviolate, may it be granted to me to enjoy life and the practice of my art, respected by all men at all times. But should I trespass and violate this oath, may the reverse be my lot!’

(1493-1541)

PARACELSUS, ICONOCLAST OF MEDICINE

PARACELSUS, ICONOCLAST OF MEDICINE

A striking similarity with the doctrines of Darwin is found in the view of Paracelsus, that the origin of everything is simply the transformation of germs always existing (and therefore is a metamorphosis), as well as in the fact that he maintained that every object and being originated at the expense of, and thru the destruction of, another—a doctrine in which we see already developed the war of individual against individual, and the struggle for existence, so much talked about now-a-days.

BAAS: *History of Medicine.*

All diseases, according to the prevalent idea, came from excess in either bile, phlegm, or blood. Paracelsus maintained that each disease had its own definite existence, with definite cause and sequences, and must be antagonized by specific remedies. This was the inauguration of the modern method of combating disease. No progress was possible until this view of its nature was adopted.

VENABLE: *History of Chemistry.*

THE road that leads to the inaccessible rock called Browning requires sturdy legs for climbing. Yet the ascent is not barren: on the rugged summit, lilies cannot grow, but the edelweiss thrives. This most enigmatical of poets has written a poem on the most enigmatical of scientists. The production is long, sometimes tedious and often incomprehensible, but it contains this immortal passage:

Are there not, dear Michal,
Two points in the adventure of the diver:
One—when, a beggar, he prepares to plunge,
One—when, a prince, he rises, with his pearl?
Festus, I plunge!

Here we have an epitome of the life of Paracelsus. He did not stand on the shore of conventionality and admire the treasures that antiquity had gathered. He was a dauntless diver, and stripping himself naked, he leapt into unknown seas of thought. The pearls with which he rose are for us to exhibit in the pages that follow.

Everything connected with this man is remarkable, even his full name: Philippus Aureolus Theophrastus Paracelsus Bombastus von Hohenheim. It has been calculated that he received only two-fifths of this at baptism. For instance, he coined the name Paracelsus to indicate his superiority to Celsus.

He was born at an interesting time: when Europe stretched her limbs after a sleep of a thousand years in a bed of darkness; he lived during the period that Columbus discovered America, and Luther cleft Catholicism in twain, and Copernicus remodeled astronomy.

His birthplace was near the little Swiss town of Maria-Einsiedeln,—where the Black Virgin is still worshiped. Fame selects odd places to lay her children. Perhaps because she is whimsical and knows they will not be lost. Boerhaave was born in the village of Voorhout; he sleeps in the medical Valhalla.

The mother of Paracelsus was the superintendent of a hospital. His father—the illegitimate son of a grandmaster of the Teutonic order—was a physician of repute. His father was his first teacher, and the turbulent son ever venerated his memory. When a parent earnestly undertakes to educate his child, the result is brilliant,—provided the child is brilliant. The fathers of Hippocrates and Galen had reason to think so. So did the sire of Paracelsus.

It is believed that when Paracelsus was three or four years old he was castrated by a hog. According to others it was a drunken soldier, while still others say it was his own father who performed the act. It is agreed that Paracelsus had no connections with women; yet it was he who introduced mercurials for syphilis. Some claim that because of his emasculation, Paracelsus never had a beard, but there are passages on record in which Paracelsus boasts that there is more wisdom in his beard than in the heads of all the ancient sages. Paracelsus appears to have been rachitic in his youth, and like many rickety children was precocious.

He never graduated from a college. He read few books and kept no library. But the amount and extent of his travels were astonishing. He is certainly the Marco Polo of medicine, tho several of the ancient physicians — Hippocrates, Dioscorides, Galen,—likewise heard the call of the wanderlust. He roamed over half the world: he saw old Tartary, Egypt was traversed by him, he stood in India and beyond. And everywhere he sought to acquire knowledge from all peoples: peasants, thieves, fortune-tellers, musicians, midwives, barbers, gypsies, bath-keepers, loafers, old women,—and even from physicians.

His restless eyes were ever open for truth, his unsatisfied spirit sought relief in discoveries. He scorned the written works of the past. He believed in independent meditation and original observation,—which is all very well for an ingenious and daring thinker like Paracelsus, but would never do for all our internes and externes. One needs keen eyesight to read the book of nature. ‘My accusers,’ he remonstrates in his piquant and poetic style, ‘complain that I have not entered the temple of knowledge thru the legitimate door. But which one is the truly legitimate door? Galenus and Avicenna or Nature? I have entered thru the door of Nature: her light, and not the lamp of an apothecary’s shop has illuminated my way.’

Paracelsus was an iconoclast: he had no use for the medicine of his day. His aim was to reform it from beginning to end. He was not the highest type of the reformer. He had not the calm dignity and lofty reserve of Giordano Bruno, he lacked the sublimity of Spinoza, and the modesty of Darwin was not his. He had a streak of clownishness in him and possessed the elements of a buffoon. He was often as gross as the aristocrats of his time, and could have engaged in drinking-bouts with Martin Luther. His self-advertising habits were distasteful. Paracelsus blew noisy blasts on his own horn. He covered his breast with medals, and his brow was decked with laurels of his own plucking.

He sang odes in his own honor, and was never weary of celebrating his great self. There was a complacent cocksureness about him that would have roused the ire of a turtle-dove. 'Tell me, Galenic doctor,' he jauntily asks, 'on what foundation you stand? Have you ever cured Podagra, have you ever dared to attack leprosy, or healed dropsy? Truly I think you will be silent and allow that Paracelsus is your master. If you really wish to learn, listen to what I say, attend to what I write.' Such vanity overtops the loftiest peaks of his native Alps. Compared to Paracelsus, the magpie is shy and the peacock modest. Now we have said the worst about him; but does it explain how he discovered Zinc?

It is fortunate for medicine that Paracelsus did not succeed in wiping out Galen, who was the more scientific and less fantastic of the two. Paracelsus lived in superstitious times, and was a son of his age. He believed there were spirits in the air, gnomes in the earth, nymphs in the water, and salamanders in the fire. He reveled in the mysteries of the kabala; he adored astrology; he was an adept in alchemy; he invented the alkahest. From his wanderings in the Orient he brought home outlandish mixtures of spiritism, theosophy, occultism, and other crazy creeds which find adherents even in the twentieth century.

But it is extremely fortunate for medicine that Paracelsus fought Galen, for the physician of Pergamus cast an hypnotic spell over the profession. For several centuries physicians argued in this manner: 'Galen said so; ergo, it must be so. Not all your experiments or observations are of any value.' New evidence was not permitted to displace Galen's old errors. In this poisonous atmosphere Science could not breathe. When we recall such criminal reverence for authority, we can forgive the dictum of the judicious Boerhaave: 'Galen has done more harm than good.'

Paracelsus did not tread the accepted path with closed eyes. His radicalism was needed, his influence was healthy. He who breaks up superstitious veneration for the past, be-

comes a benefactor of the future. His fault lay in his attempt to replace the authority of Galen by the authority of Paracelsus, and for this he is blameworthy. But he was the yeast that leavened the medical dough. The lance of his free wit punctured many an orthodox error. He smote the pedestals of falsehood, and the unclean images fell. *Festus, I plunge!*

Paracelsus' conception of medicine was due to a sort of neo-platonic pantheism — whatever that may be — and was based on the relationship that man the microcosm bears to nature the macrocosm. 'There is nothing in heaven and earth,' he says, 'which is not in man, and God who is in heaven is also in man.' He believed that diseases were caused by the action of certain constituents in the universe acting on the corresponding elements in man. Therefore in order to be able to treat man, it was necessary to understand all nature. No theory could well be more irrational than this, and it naturally led Paracelsus to serious errors. For if disease is due to a conflict between the macrocosmus and the microcosmus, it follows that Astrology is more important for a physician than Anatomy, and it seems that Paracelsus actually thought so!

Paracelsus claimed that medicine rests on four pillars: Philosophy, Astronomy, Alchemy, Virtue. He defined these terms differently than we do now, but on the whole we may say that these pillars, like the columns of the Roman Forum, have fallen: a test-tube is stronger than them all.

Paracelsus agreed with Basil Valentine that man and the entire universe were composed of three primary mystic elements: mercury, sulphur, salt. Whatever sublimates is mercury; whatever burns is sulphur; whatever remains is salt.

He anticipated the mesmerism of Mesmer, and the *similia similibus curantur* of Hahnemann — for which anticipations we need not be especially thankful to him.

Paracelsus believed that medicines, like women, were known by their shapes. It was his theory that everything in nature

was made for the human race, and that God put his signature on all drugs. The orchis-root is testiculate and therefore should be used for diseases of the testicle; the flower of the euphrasia has a black spot which indicates that it should be used for the pupil of the eye; if a plant has more than one color, it means it possesses more than one therapeutic property; the juice of celendine is yellow, and consequently good for jaundice; the spines of a thistle will heal pains in the side. Why should frogs be used for plagues? That's easy; because frogs are disgusting and plagues are disgusting.

Of course Paracelsus had many recipes for the prolongation of life. And not only did he think we could live indefinitely, but he believed a human embryo could be created by chemical means. This is now considered impossible, but before 1828 it was likewise deemed impossible to manufacture an organic compound in a laboratory. Paracelsus' dream may yet be realized; surely Jacques Loeb has made a magnificent beginning. But this is perhaps a problem for the twenty-fifth century.

Little will here be said concerning Paracelsus' notions on Magic. We have scant inclination to elucidate his aniadum and aquastor, or explain his evestrum and erodinium. We feel no interest in his hidden iliasters, ultimate essences, sidereal bodies, astral corpses, haunted houses and poisoned moons. Expositions of such vagaries may well be left to unsound mediums like Helen Blavatsky and insane mystics like Franz Hartmann.

Out of these voluminous writings on Mystery we will content ourselves with two short extracts: the first, disgusting; the second, delightful. In *De Pestilitate* he says, 'But if a witch desires to poison a man with her eyes, she will go to a place where she expects to meet him. When he approaches she will look into the poisoned mirror, and then, after hiding the mirror, look into his eyes, and the influence of the poison passes from the mirror into her eyes and from her eyes into the eyes of that person; but a witch may cure her own eyes

by making a fire and staring into it, and then taking the menstrual cloth, and after tying it around a stone, throwing it into the fire. After the cloth is burnt, she extinguishes the fire with her urine, and her eyes will be cured; but her enemy may become blind.'

From his *De Morbis Amentium* we quote a pleasanter passage: 'Some will fall deeply in love with the person who administered to them these philtres prepared by sorcerers; and it has happened that in this way masters and mistresses have fallen deeply in love with servants who administered them such things; and thus they became themselves the servants of their own servants. Even horses, dogs and other animals have thus been brought under the influence of such spells. If women administer such things to men the latter may fall so deeply in love with the former as to be unable to think of anything else but them; and if men administer such things to women, the latter will continually think of them.'

So far the reader has had no glimpse of the promised Paracelsian pearls. Let us begin by stating that altho Paracelsus himself was a star in the alchemical sky, he asserted 'the object of true alchemy is not to make gold but to prepare medicines.' It was he who made chemistry the handmaid of medicine, and inaugurated the era of iatro-chemistry. *Festus, I plunge!*

His followers — Spagyrist they were called — ceased to look for the Philosopher's Stone that cures the diseases of metals, and commenced to search for various remedies to heal the ills of mankind. Paracelsus himself enriched the *Materia Medica*.

Tin was known from the remotest antiquity, Moses and Homer mention it, the Phœnicians traded in it a thousand years before Christ, but it remained **for Paracelsus** to suggest the use of *stanni pulvis* as an anthelmintic.

Paracelsus brought Antimony into special vogue, but credit for first mention of its medicinal properties belongs to that

strange monk, Basil Valentine. We do not know of anyone who employed the lead salts for internal treatment, prior to Paracelsus. He had much to do with the introduction of copper sulphate into therapeutics. He was largely instrumental in adding iron salts and milk of sulphur to the medical armamentarium.

The discovery of zinc must be accredited to Paracelsus; at any rate he is the first to mention zinc as a separate metal, distinct from its alloy. The passage in which he refers to it is worth quoting for historical reasons:

‘There is another metal, zinc, which is in general unknown. It is a distinct metal of a different origin, tho adulterated with many other metals. It can be melted, for it consists of three principles, but it is not malleable. In its color it is unlike all others, and does not grow in the same manner; but with its *ultima materia* I am as yet unacquainted, for it is almost as strange in its properties as *argentum vivum*. It admits of no mixture, will not bear the *fabricationes* of other metals, but keeps itself entirely to itself.’

He was the first to use zinc oxide and zinc sulphate medicinally; he showed how to purify the latter. As far as we know, Paracelsus was the first who was acquainted with ethereal oil.

Paracelsus’ favorite remedy was what he called laudanum, — which to-day means tincture of opium. The interesting and even important question arises if his laudanum was similar to *laudanum liquidum Sydenhami*. Nearly all authors answer in the affirmative, but Dr Monsarrat denies it with angry emphasis, and hotly insists that Paracelsus’ laudanum never even saw opium. It should be remarked, however, that Dr Monsarrat sees little good in Paracelsus. There is no doubt that Paracelsus, against the opposition of the Galenists, did much to advance the therapeutic reputation of opium — tho we are here met by the puzzle that Galen himself had recommended it.

It follows that Paracelsus’ idea that chemistry should be

an adjunct of medicine, his advocacy of numerous mineral remedies, the impetus he gave to the preparation of new drugs, considerably enlarged the scope of pharmacy, which up to that time concerned itself chiefly with roots and herbs, syrups and the like.

Paracelsus did praiseworthy work in combating the polypharmacy of his time, which put hundreds of ingredients in a single prescription. 'Bah!' he exclaims, 'this miserable compounding business! Yet the woman requires only one man to father her child; many seeds only corrupt it. Mix many kinds of seeds and bray them like an apothecary and bury them in the earth; no fruit will come from them.'

By treating iron filings with oil of vitriol Paracelsus noticed a gas whose evolution he referred to as 'the rising of a wind.' This is the first mention of hydrogen; but of course Paracelsus did not know its elementary nature, and confused it with air. Not he, but Henry Cavendish must be considered the discoverer of our lightest element.

Mercury was employed externally by the Arabians, as a remedy for vermin and cutaneous diseases; but to Paracelsus we are indebted for its internal administration in syphilis. This alone should be sufficient for immortality. From that time on, mercury remained the specific for this loathsome affliction.

A few days ago, while recording my impressions of the French capital, I wrote these words: 'Many who come to the gay city to worship Venus, remain there to pay tribute to Mercury. Just as in New York there is a sorrowful Bread-Line which waits for its daily loaf at Fleischmann's Bakery, so in Paris there is a pathetic Lues Line which waits for its mercurial injection at the Hospital Cochin. Who shall say which is worse—the horrors of starvation, or the ravages of that pale spiral bacillus? But this much is certain: the best medicine for the malady of hunger is bread, and the best remedy for the disease of syphilis is mercury.'

My paragraph is no longer true; the most recent text-books

are now antiquated; mercury has been superseded; the science of medicine does not sleep! The therapeutic world is tingling at the news of the most important discovery since Serturmer isolated morphine, and Pelletier and Caventou extracted quinine from cinchona. Paul Ehrlich announces a remedy which may cure syphilis in a single injection: no more months and years of mercury. It is an arsenical preparation, somewhat akin to atoxyl, chemically paradioxydiamidoarsenobenzol, popularly known by its experiment number, '606.' It contains no mercury, and Paracelsus' specific may be a specific of the past.

But the history of syphilis cannot be written with the name of Paracelsus left out. Several of his original observations concerning this disease are correct. He divided it into stages, observed the heredity of syphilis, and was aware of its influence on the course of other diseases. He knew that gonorrhea was due to coitus, but he made the mistake of believing it to be an initial stage of syphilis, and therefore labeled it French gonorrhea.

This error, tho a serious one, is not surprising, when we recall how strenuously the unity of the gonorrheal and syphilitic virus was upheld by the acute John Hunter, who had moreover the advantage of living in the eighteenth century. Hunter, for experimental purposes, inoculated himself on the prepuce and glans, with the pus of a virulent gonorrhea; unhappily, the subject from whom he took the poison had also a chancre in his urethra; the result was that Hunter developed not only gonorrhea but syphilis. Thereupon the illustrious and heroic experimentalist proclaimed that a gonorrheal secretion produces syphilis, and that there is but a single venereal virus. Folks were not in the habit of holding interrogation marks up to John Hunter; what he said, the profession believed; his disastrous mistake was persisted in until the syphilological work of Phillipe Ricord straightened out matters. Once again do we see the fatal results of following authority blindly.



PARACELSUS

Hunter had also written, 'I have not seen that the brain, heart, stomach, liver, kidneys, and other viscera have been attacked by syphilis, altho such cases have been described by authors.' On account of this flippant and careless statement, nothing further was said of visceral syphilis for over half a century! Comment is superfluous; as the lawyers say, *res ipsa loquitur*.

In the sixteenth century there was a chasm of animosity between Medicine and Surgery, but Paracelsus was a member of both branches. He was the first to point out the connection between goitre of the parents and cretinism of the offspring; his description of hospital gangrene is admirable; his ideas on the treatment of wounds were more rational in several respects than those of his contemporaries; he declared that suppuration was bad healing and insisted on the cleanliness of wounds; across the centuries let Lister greet his precursor.

As a rule, the German historians regard Paracelsus more favorably than do the medical authors of other nations. No doubt they are grateful to him because he was the first scientist to write in the German tongue,—and he wrote like a literary master. He knew the value of antithesis, and when his ink-horn felt the quill, it became a crucible that coined golden epigrams.

He has another connection with literature: the Englishman of letters seems fond of him. Paracelsus has the exceptional honor of being mentioned by Shakespeare, who in his comedy, *All's Well That Ends Well*, puts this phrase in the mouth of Lafeu: 'Both of Galen and Paracelsus, of all the learned and authentic fellows.' Bacon praises his endeavor to get at the truth thru the light of experience. Another Elizabethan — O rare Ben Jonson! — refers to Paracelsus in his drama *Volpone*; Samuel Butler, in his celebrated *Hudibras*, speaks of the laudanum which Paracelsus kept in the pommel of his long sword; Kingsley praises him wholeheartedly; but his staunchest supporter is Robert Browning, who in a note

to his poem goes so far as to state that Paracelsus is the discoverer of the circulation of the blood, and the father of modern chemistry.

There is probably no character in general history, and certainly not one in medical history, about whom such diverse estimates have been expressed as of Paracelsus. To Zimmermann he is an ass; to Hans Locher he is the greatest of Swiss physicians; to Freind he is a loud-mouthed humbug; to Jules Andrieu he is the best of men; to Dr Dalton he is an ignorant vagabond; to Creighton he is a sagacious reformer; to Thorpe he is a worthless charlatan; to Baas he is a high-minded professional man; to Monsarrat he is a parasite hanging on the skirts of science; to Venable he is the torch that lit up the darkness of his age. Perhaps I am expected to be wise and say that the truth lies in the middle, but may the memory of Theophile Gautier's wit save me from such hackneyed business.

A sapient Frenchman said, 'Calumniate! Calumniate! Calumniate! — some of it will stick.' Paracelsus had numerous enemies, and some of it has stuck. Slander of Paracelsus yet comes from those who find his independence annoying, and his exuberant originality irritating. But to call Paracelsus a charlatan is to cast undeserved glory on the filthy tribe of Munyon, Bernarr Macfadden, and their swindling confreres. Paracelsus was irregular, because he was ahead of the medical knowledge of his day; the average quack is irregular because he has not the capacity to pass the college examinations. A quack has one object — to get rich quick. Had Paracelsus been willing to conform to authority he would have attained to great wealth, but he always remained poor. 'My poverty,' he says, 'was thrown in my face by a Burgo-master who had perhaps only seen doctors attired in silken robes, never basking in tattered rags in the sunshine. So it was decreed I was not a physician.'

Paracelsus tells us why he became a reformer: 'Since I saw that the doctrine accomplished nothing but the making

of corpses, deaths, murder, deformity, cripples, and decay, and had no foundation, I was compelled to pursue the truth in another way, to seek another basis, which I have attained after hard labor.' He had a noble conception of the duty of a physician, and was so anxious to cure that he exclaimed, 'If God will not help me, so help me the Devil!' In the presence of the sick, Paracelsus was a changed man: his arrogance and bombast turned to humanity and charity. His heart was naturally noble, and at such times especially so. He felt himself a father to the patient; this proves he was not a quack, but a genuine physician. The maimed, the diseased, the suffering, came to him.

A man named Bartholomew who had for two years a pain in his side, a woman who had a great swelling on her thigh, a soldier who was shot in the breast with a forked arrow, a young man who had a crusty ulcer on his chin, one whose stomach was swollen and standing out, a lad whose finger was eaten to the bone with disease, a goldsmith whose skull had been injured, one Jonas who fell in love with one Sabina and then fell beside himself, the daughter of one Oliver who was pale and ate small stones and chalk, a boy of eighteen who had a black bladder appear where a tooth was drawn, a young gentlewoman named Ascania who had pain all over her body, one who had a flux of blood from a severed artery, a knight who suffered a stroke of apoplexy, a man of the country who was stung by an adder, one who was wounded in the tunicle of the heart, a young man who was vexed with a continual and violent cough, a certain woman who was troubled with a disease in her secret parts, one named Vermundus who was so weak in his head that he staggered as if drunk, a fair young man who was infected with the pox thru the filthy sin of the Sodomites, one named Gallenus who had lost his speech, one who was troubled with a great burning of the urine, one who had a cataract of the eyes, a woman whose courses were so long that she was ready to give up the ghost, a sucking child whose palate was full of pustules,

one Gotius who had a bone out of joint for several days, a lawyer who was long sick of the colic, a man of threescore years who was full of melancholy humors, a woman who three months after conception feared abortion, a certain man who had carnal company with his wife but could void no sperm, a certain Queen who thru the retention of her menses had her tongue inflamed, a German prince who was sick with the frenzy, a gentlewoman of name who was troubled with a suffocation of the matrix, a certain baron who was sorely afflicted with syphilis: these came with faith to Paracelsus, and the great physician healed many wounds, and many invalids became whole and sound.

Because of his famous cures, Paracelsus was made professor at Basel—the city thru which Vesalius passed, and further to be renowned in science as the residence of the mathematicians Euler and Bernoulli, the anatomist Sylvius, the surgeon Wurtz, the physiologist Haller, the physicist Schönbein, the embryologist William His.

In this pretty town, near a chestnut-covered terrace that overlooks the hills of the Black Forest, still stands the house where lived two illustrious friends and patients who sought health at the hands of Paracelsus—Frobenius the printer, and Erasmus the philosopher.

So Paracelsus came to the University, looking as natural as the portrait of himself, painted by the great Tintoretto. He regarded the students with those strange eyes which have been described by Charles Kingsley as ‘wild, intense, hungry, homeless, defiant and yet complaining eyes; the eyes of a man who struggles to tell a great secret, and cannot find words for it, and yet wonders why men cannot understand, and will not believe what seems to him as clear as day.’

The new Professor did many astonishing things that day. Instead of using the monkish Latin, he lectured in native German, which then seemed ‘even to the German emperor, suitable only to address horses.’

Paracelsus had with him a pile of books—the works of

Galen, Avicenna, Averroes and other medical masters. It was surprising to see the iconoclast in company with these authorities. But Paracelsus did not quote from them. He placed some sulphur in a brasier, set fire to it, cast in the sacred volumes, and burnt up the idols. *Festus, I plunge!*

'Follow me,' he cried, 'not I you, follow me Avicenna, Galen, Rhazes, Montagnana, Mesuë, and ye others! Follow me, not I you! ye of Paris, Montpellier, ye of Suabia, ye of Meissen, ye of Cologne, ye of Vienna and the banks of the Danube and the Rhine, ye islands of the sea, Italy, Dalmatia, Sarmatia, Athens, ye Greeks, ye Arabs, ye Israelites, not one of you shall remain in the remotest corner upon whom the dogs shall not void their urine! How does this please you, Cacophrastus? This dung must ye eat! And ye Calefactores, ye shall become chimney-sweeps! What will you think when the sect of Paracelsus triumphs? I am to be the monarch, and the monarchy will belong to me. For I tell you boldly that the hair from the back of my head knows more than all your writers put together; my shoe-buckles have more wisdom in them than either Galen or Avicenna; and my beard more experience than your whole Academy.'

Paracelsus was not the sort of man who can occupy official positions. He disturbed the doctors in their commercial transactions. In his capacity of town-physician, he demanded to examine the drugs of the apothecaries, to see if they were of sufficient purity. Basel became a vat where trouble brewed. It was discovered that Paracelsus had no degree. Objection was found to his unprofessional dress. He was accused of immorality. His servant testified that for his own amusement Paracelsus often conjured up legions of devils.

About this time Paracelsus and a prelate agreed that if the skill of the former could remove the sickness of the latter, one hundred florins should be the reward. Treatment was commenced, and the disease disappeared so swiftly that the churchman thought six florins would be adequate pay-

ment. Paracelsus brought the matter into court, but the judges found it convenient to forget the law of contract, and rendered a verdict for the defendant. Enraged words leaped to the eloquent tongue of that pugnacious plaintiff, and treating the bench as if it was a prisoner, and he himself the magistrate, Paracelsus delivered a lecture on justice. The legal lights of Basel determined to punish this trespass into the realms of jurisprudence. The friends of Paracelsus got wind of the matter; they informed him, and he fled.

For the rest of his life Paracelsus was a homeless wanderer. In 1528 he was at Colmar; in 1529 at Nuremberg; in 1530 at Munich, Amberg, Noerdlingen, Regensburg; in 1531 at St Gall; in 1535 we find him at Appenzall, Zurich, Pfeffers; in 1536 he journeyed to Augsburg; he was at Villach in 1538; in 1540 he was at Mindelheim; in 1541, under the protection of an archbishop, he came to Salzburg in the Tyrol; he needed rest, and soon found it.

In a little inn called the White Horse, he died,—as the result of a long debauch, his enemies say.

And at my door the Pale Horse stands,
To bear me forth to unknown lands.

Three hundred and fifty years later his skeleton was unearthed for reburial; an examination revealed the fact that his skull was smaller than the average, having a capacity of 1300 cubic centimeters, instead of the usual 1450. But a more curious discovery was made. A fracture was found on his temporal bone which the surgeons declared could have been made only during life. To-day many believe he was assassinated by hirelings of his foes. It is doubtful if the truth will ever be known.

A contradictory character; he blundered much; his mistakes were manifold, but he had some great ideas, and this is a virtue that few possess.

Jacobus Sylvius was an element: he was a disciple of Galen, and could not be subdivided into anything else. Haller was

an harmonious compound: the elements in him were united in certain definite proportions. Paracelsus was a strange mixture: the multitudinous elements that entered into his cosmos were erratically arranged.

In spite of his adherence to mysticism he had the great intelligence to say, 'Ere the world perishes, many arts now ascribed to the work of the devil will become public, and we shall then see that the most of these effects depend upon natural forces.'

Festus, I plunge!

(1511-1553)

SERVETUS, THE MEDICAL MARTYR

SERVETUS, THE MEDICAL MARTYR

Since the ancients have no right to so noble a discovery as that of the circulation of the blood, it may be worth while to inquire, to whom of the moderns the glory of it is due; for this is also exceedingly contested. The first step that was made towards it, was the finding that the whole mass of the blood passes thru the lungs, by the pulmonary artery and vein. The first that I could ever find that had a distinct idea of this matter, was Michael Servetus, a Spanish physician.

W. WORTON, in 1694.

AN orange orchard in Hispania, with olive trees upon the hills, a fountain weeping crystal tears by moonlight, an ancient castle in the distance, a golden-sanded river flowing along a flower-laden shore.

Paler yet than ever the lover looks to-night, and gently his trembling fingers tinkle the guitar. He nears the silvery fountain so its dashing spray can cool his heated brow. The night-air bears his song of sorrow to the moon, but no fair hand is at the lattice, and no sweet face peeps forth from the casement.

His passion rises, a string breaks,—of the guitar only? His stricken voice halts in his throat, he is silent. . . . The green-leaved vines climb upon the wall—up to her chamber-window. He will cling to them, he too will raise himself,—up to her chamber-window. He climbs, he whispers, no answer, he calls, he cries *misericordias*, he waits, a faint step—O, with what a mad and fevered ecstasy he lifts his free hand to the moon! The step comes closer, the air grows sweeter, heaven draws nearer,—she opens her chamber-window. She speaks, ‘My love, I come to thee.’

They walk in the garden below. How fragrant are the orange-blossoms to-night, and so musically the cascade falls,

— is it keeping time with a Spanish love-ditty? Dip thy fingers in the fountain, perilous maiden, and soothe the youth's fevered brow, for he burns and the fault is thine. False was the advice,— who would not go blissful delirious at thy touch? Ah, beauty of Spain, be kind,— what night better than this? With the moon for a marriage-ring, the white blossoms for thy bridal veil, the olive trees for canopy, the flowing cascade for hymeneal song, and the voice of the nightingale for priest? They melt into each other's arms, they swoon with the passion divine.

Sweet-night, dream-night, love-night,— must thou end? A cock is crowing for the dawn, but the moon tho wan, still glimmers in the heavens, therefore, sleep yet on. . . . The cock crows again,— lustily. Alas, that those entwining arms should be released. The sun is above thee — awake.

'The day is abroad,' speaks Michael Servetus, 'and I must go.'

'Ah me,' she sighs, 'do not go from me. Linger yet awhile within the shadow of my olive trees.'

'I leave this land' answers Michael Servetus, 'even now the Inquisitors search for me and the sun is red.'

And something sombre and severe
O'er the enchanted landscape reigned
A terror in the atmosphere
As if King Philip listened near,
Or Torquemada the austere,
His ghostly sway maintained.

The spirit of Spain was expressed by Isabella: 'In the name of Christ and his maidmother,' said the Queen, 'I have caused great misery, and have depopulated towns and districts and provinces and kingdoms.' In the soft warm land of Spain the *auto-da-fe* was in its glory, and the curling smoke from the hell-fires of the Inquisition mingled with the sailing clouds, and cunning instruments were plied upon the sensitive nerves of pain, and the ruddy life-fluid of Hebrews reddened the dirty gutters, and darkened chambers heard the

shrieks of mangled unbelievers, and in sympathy the crimson sun streaked the Spanish sky with blood!

Michael Servetus came from Spain. Spain was a good country for a thinker to come from. That is, it was better to come from there than to stay there. Servetus left Spain to escape the fagots of the Inquisition — he had no desire to die in a scorching blaze. He thought the Protestant countries would be more tolerant than his Papist Hispania.

Servetus was mistaken when he imagined that the Lutherans and Calvinists would permit independent speculation. These men broke away from the tyranny of the Popes — but they established a tyranny of their own. Nor were they more favorably disposed towards science than the older ecclesiastics — they accepted only the science of the Pentateuch. When Copernicus published his book on the orbits of celestial bodies, the Protestant joined with the Catholic in a chorus of denunciation, and Luther himself declared, ‘The fool wants to upset the whole science of astronomy, but as Holy Scriptures show, Joshua commanded the sun to stand still, and not the earth.’

Servetus was the greatest man of his age. His brain was the torch that burned to enlighten the world. He was the irritant that caused the sixteenth century to turn uneasy in its sleep. It could not rest till he was off the earth. No nation was big enough to hold him — he came, he taught, he was banished. Servetus was beyond the Renaissance. Nearer the truth than his contemporaries, Servetus was a type of the intellectual outcast.

Whatever subject he touched, he illumined. When he edited the geographical work of Ptolemy, his notes showed that he did not consider geography merely a matter of maps. His intellect was broad enough to grasp the connection that geography had with botany, zoology and astronomy. He was the first to recognize this important relationship of the sciences, and Tollin and other authorities consider him the Father of Comparative Geography.

In the preface, Servetus, writing as a geographer and not as a panegyrist, said: 'Judea has been falsely cried up for beauty, richness, and fertility, since those, who have traveled in it have found it poor, barren and utterly devoid of pleasantness.' Because of this statement he was accused of attacking the authority of Moses, who had described Judea as a land overflowing with milk and honey!

His theological views, of a pantheistic nature, caused him to be equally abhorred by Catholic and Protestant. Michael Servetus did not believe in the Trinity, was tolerant to Jews and Moors, and bothered little with Original Sin and Baptism of Infants. Therefore Martin Bucer, who is described as a very moderate man, used very moderate language and said that Servetus should only be torn to pieces and disembowelled. And Philip Melancthon, whom everyone called mild, wished in a mild sort of way that the heretical Spaniard should merely be done to death by sword or fire.

The book in which Servetus first set forth his heterodox opinions was published at Haguenau in 1531 and entitled *De Trinitatis Erroribus*. It brought him into collision with a theologian who believed strongly in the Trinity. He was an uncanny individual — everything that was human was alien to him. He was a cold soul, and could warm himself only at the flames of hell. His only joy consisted in contemplating the fact that at least nine-tenths of mankind were predestined to eternal damnation. He was not ashamed to declare that the infant, while yet in the mother's womb, was already an abomination to God. He formulated a theological system so pitiless, that if the lower animals could understand it, throughout the jungle would run a shudder at the inhumane dogmas. His *Ordonnances Ecclesiastiques* were iron rules which were enforced with unyielding rigor. He not only announced the opinions that his flock at Geneva must entertain, but he prescribed the garments that all must wear. He whipped a girl for singing a song. He considered himself a reformer; he broke away from the tyranny of the Popes, but he established

a theocracy of his own — including a Protestant Inquisition. Spies eavesdropped among the people; for any nonconformity, howsoever slight or unintentional, the harshest punishments were administered; physical measures were employed, and often the cries of tortured prisoners made Switzerland resemble Spain. He might even be willing to burn a heretic. No doubt this man was sincere, but he was also conceited: he thought an insult to John Calvin was blasphemy against God.

Calvin engaged in polemics with Servetus. Servetus defeated him. At least that was the general opinion at the time, and when Calvin heard a laugh at his expense, wounded pride rankled in his unforgiving bosom; furious and malevolent, he waited for revenge. But enough of Calvin — for the present; we may meet him again.

At Lyons, while engaged in editing scientific works for the firm of Trechsel, Servetus became friendly with the physician Symphorien Champier. Dr Champier, like the other scholars of the period of the Revival of Learning, eulogized Hippocrates and Galen in highest hyperbole; he clamored to see them in their own dress, for altho the Greeks had remained authorities all during the Middle Ages, they were not known in the original, but only thru faulty translations, and by means of commentaries and compilations, chiefly from Arabic sources. The enthusiasts refused to drink any longer from these second-hand sources — they thirsted for the fountain-heads of knowledge. On all sides was heard the cry for Greece and Rome; Christian, Hebrew and Mohammedan, gave way to the resurrected glory of Hellas. The awakened cities fought, not for the spoils of war, but for classic manuscripts.

In those days Lyons was one of the intellectual centers where Athens was born again. Besides Champier and Servetus, Rabelais was there, fresh from his lectures on Hippocrates and Galen at Montpellier, now editing the *Aphorisms* of the former and the *Ars Parva* of the latter. But it was not as a physician that the world's greatest humorist was to earn his laurels.

At Lyons was also Rabelais' friend, the talented Etienne Dolet, loud in his praises of Cicero, and printing everything interesting that came into his hands — but not for long, for the theological faculty of the Sorbonne accused the young man of atheism, and he was strangled and burnt. Ah, medievalism was not dead, after all. It was a dangerous age for a thinker like Michael Servetus.

Servetus decided to follow the profession of Champier, and accordingly registered at the renowned University of Paris. Jacobus Sylvius, who has given his name to the artery, aqueduct and fissure of Sylvius, was the shining light of the faculty; he possessed ability — and a despicable character.

A more interesting personality was Joannes Guinterius. Here was a man who had risen from the depths; he had stood in the streets of Deventer, imploring the passersby for bread. But hunger never prevented Guinterius from studying Greek, and the learned beggar became a professor in the University of Louvain. But even success did not chill his passion for knowledge, and at the age of forty he began to study medicine. After graduation, he remained in Paris, practicing and teaching, and translating the Greek physicians into Latin. Other events crowded into his career; when the Reformation came, Guinterius sided with Luther, and his life was endangered; he wandered from place to place, but romance dogged his footsteps, and Guinterius eventually became a nobleman of Strassburg.

Guinterius was delighted with the vivacious Servetus. Guinterius had another pupil whom he admired — a Netherlander whose scalpel opened up the era of modern medicine — and the teacher linked the names of these earnest scholars: 'Andreas Vesalius, a young man, by Hercules! of singular zeal in the study of anatomy; and Michael Servetus, deeply imbued with learning of every kind, and behind none in his knowledge of the Galenic doctrine. With the aid of these two, I have examined the muscles, veins, arteries and nerves



SERVETUS

of the whole body, and demonstrated them to all the students.'

In 1538, Servetus graduated with the highest honors. He became a lecturer at the university on the medical sciences and mathematics, and his wide and varied culture attracted distinguished visitors, including the Archbishop of Vienne, whose confidential physician Servetus became.

A life of peace, and much glory and money would have been his, had he been able to keep his critical faculty in abeyance. But this was the one thing Michael Servetus could not do. He published a learned medical work, *Syruporum Universa Ratio*, in which from a therapeutic and physiological standpoint he criticized the great Galen, whose pre-eminent authority as an anatomist was after an elapse of fourteen centuries at last to be undermined by the publication of Vesalius' monumental *De Humani Corporis Fabrica*, while his knowledge of obstetrics was attacked by the famous midwife, Louise Bourgeois, who claimed that the unmarried master never knew the pregnant uterus of a woman. It was not only Galenism, but the Arabian system which was then much in vogue, that Servetus sought to displace.

His book was a distinct advance in the art of prescribing. For the nauseous mixtures — the mere names of which now act as emetics — he introduced more palatable drugs; in these pages we see the first rational attempt to avoid incompatibilities, and we find also the first suggestion of what the pharmacist calls vehicles, that is, pleasant-smelling and sweet-tasting ingredients of no use in themselves, but valuable as carrying other drugs of therapeutic action.

In those days people took books seriously, and *Syruporum Universa Ratio* aroused intense antagonism. The Faculty of Paris attempted to impeach Servetus. Dissensions divided the university, riots occurred in the streets, and some of the students were severely injured. Who to-day would get excited over a treatise on sweetened syrups?

It must be admitted that Servetus was not averse to argumentation. He had a ready tongue and a facile pen — and

he liked to use both. There must have been a sort of child-like vanity about him, for he sent Calvin one of his manuscripts and asked him what he thought of it.

A stranger rode into Louyset, and the next day wandered into Geneva, where he earnestly asked for a boat to take him toward Zurich on his way to Naples. He had escaped from prison, and like Baumgarten in Schiller's *Wilhelm Tell*, might have exclaimed:

Then must I fall into the tyrant's hands,
And with the port of safety close in sight!
Yonder it lies—I reach it with mine eyes,
My very voice can echo to its shores;
There is the boat to carry me across;
Yet here despairing, helpless must I lie!

Unhappier was his fate, for instead of the helping hand of the Swiss hero to row him thru the storm in safety, the despotic voice of Calvin, like a second Gessler, was heard commanding his immediate arrest. Servetus was again imprisoned, and the Christian Hercules (as Beza called Calvin) labored for a death-sentence.

The trial lasted from August till October, and several passages deemed heretical were read from Servetus' latest book, which had recently been published — *Christianismi Restitutio*. Calvin, tirelessly malignant, was the chief prosecutor. There was no escape from the implacable Genevan. Servetus had defeated him once — it was now Calvin's turn. He had the infidel on the hip and he smote him hard. Yet even without Calvin, Servetus' life was in danger, for during the month of June he had been burnt in effigy at Vienne, and in July the Roman Catholic Inquisition condemned him to death. But as Calvin was anxious for the honor of burning a heretic, he would not relinquish Michael Servetus, and on October 26, 1553, his tribunal read the following judgment:

'Against Michael Servetus of Villeneuve, in the kingdom of Arragon, in Spain: Because in his book he calls the Trinity a devil, and a monster with three heads; because contrary to

what Scripture says, he calls Jesus Christ a Son of David; and says that the baptism of little infants is only an invention of witchcraft; and because of many other points and articles and execrable blasphemies with which the said book is all stuffed, hugely scandalous and against the honor and majesty of God, of the Son of God, and of the Holy Spirit; and because Servetus, full of malice, has entitled his book thus directed against God and the holy evangelical doctrine, *Restoration of Christianity*, and that for the better seducing and deceiving the poor ignorants, and for more easily infecting with his unhappy and wretched poison the readers of his said book, under the shade of sound doctrine: therefore —

‘For these and other just reasons us hereto moving, desiring to purge the Church of God of such infection, and to cut off from it a corrupt member — having well consulted with our fellow-citizens, and having invoked the name of God to guide us to right judgment, sitting on the tribunal in the place of our ancestors — having God, and His Holy Scriptures before our eyes, saying in the name of the Father, of the Son and of the Holy Ghost, by this our definite sentence which we give here in writing, we condemn thee, M. Servetus, to be bound, and led to the place of Champel, there to be fastened to a stake, and burned alive, with thy book, as well written by thy hand as printed, even till thy body be reduced to ashes, and thus wilt thou finish thy days, to furnish an example to others who might wish to commit the like.’

As said before, parts of his latest book were read as evidence against him, but there was a certain passage which the prosecution overlooked, so we will quote it here:

‘The vital spirit,’ wrote Servetus, ‘is generated by the mixture in the lungs of the inspired air with the subtly elaborated blood, which the right ventricle sends to the left. The communication between the ventricles, however, is not made thru the midwall of the heart, but in a wonderful way the fluid blood is conducted by a long detour from the right ventricle thru the lungs, where it is acted on by the lungs and becomes

red in color, passes from the arteria venosa into the vena arteriosa, whence it is finally drawn by the diastole into the left ventricle.'

Reader, this remarkable passage was the first complete account of the lesser circulation! There stood Michael Servetus, the discoverer of the pulmonic circulation of the blood, the anticipator of Harvey, condemned to death for writing the book that contained the most momentous physiological discovery of the time. So effectually was the edition destroyed, that Harvey knew not his true precursor. Harvey quotes Realdus Columbus, but not Michael Servetus. But closer than Columbus or Caesalpinus or Vesalius or Fallopius, had Servetus come to solving the riddle of the circulation. He deserved the blessings of the world, but received a death-sentence. No voice was raised in his behalf. Not only John Calvin, but all Christendom, was guilty.

As the fatal day approached, a visitor entered Servetus' cell. It was John Calvin. The prisoner looked at the pale face and burning eyes of the bigot, but remained silent. His passion for discussion had deserted him — perhaps he had cast enough invaluable pearls before uncomprehending swine. The opponents parted forever.

It was the melancholy month — October. Pensive Autumn faintly sighed, the trees had shed their glory, and the fields were filled with pain.

Under an ancient arcade the processions passed. Beneath the gate of the castle they marched. The Bourg-de-Four they crossed, and ascended the street of Saint Anthony. Southward they turned, and left the walls of the town. The Lord-Lieutenant rode a mighty horse, and by his side galloped a herald. Behind them came the archers, and in the midst of all walked a proud and taciturn physician whose prescriptions had failed to purge the age of fanaticism. A crowd swelled the rear — poor and unlearned — but not one in all that throng envied him who walked in silence.

The sick leaves moaned, the dead leaves fell. Destruction was in the air.

A little hill lay before the procession. Up this incline rode the Lord-Lieutenant, followed by the others. The summit was gained, and then the eye gazed on the scene which has enchanted a thousand inspired poets. Far away gleamed the deep blue waters of the lovely Lake of Geneva, formed like a graceful halfmoon, and on one side, as if guarding the verdant valley, towered an undulating ridge of lofty mountains.—A dying leaf shook among the branches, and losing its hold was swept away by the wind.

On the hill was set a stake around which were piled the fagots — of green wood so they would burn slowly. Michael Servetus was a devoted believer in God, and even warmly attached to the person of Christ, but because he rejected the Trinity, the multitude considered him an incorrigible atheist, and a child who was present at the execution might have used the words Shelley wrote when a boy:

I was an infant when my mother went
To see an atheist burned. She took me there:
The dark-robed priests were met around the pile;
The multitude was gazing silently;
And as the culprit passed with dauntless mien,
Tempered disdain in his unaltering eye,
Mixed with a quiet smile, shone calmly forth:
The thirsty fire crept round his manly limbs;
His resolute eyes were scorched to blindness soon;
His death-pang rent my heart! the insensate mob
Uttered a cry of triumph, and I wept.
Weep not, child! cried my mother, for that man
Has said, There is no God.

By several twists of an iron chain, Servetus was bound to the stake. To mock him, a crown of straw dipped in sulphur was put upon his head. By his side they tied the child of his brain — the book that should have made an epoch. The torch blazed, and a hot sheet of flame, as if it were the spirit of Calvin, leapt high in air and pounced upon his body.

. . . . Thru the escaping smoke Michael Servetus lifted his unseeing eyes to heaven, and cried in agony, *Misericordias! Misericordias!*

O miracle accursed — Spain had come to Switzerland — Behold, how the crimson sun did streak the skies with blood!

(1514-1564)

VESALIUS, THE ANATOMIST

VESALIUS, THE ANATOMIST

Vesalius appears to me one of the greatest men who ever existed. Let the astronomers vaunt their Copernicus, the natural philosophers their Galileo and Torricelli, the mathematicians their Pascal, the geographers their Columbus, I shall always place Vesalius above all their heroes. The first study for man is man. Vesalius had this noble object in view, and admirably attained it.

PORTAL: *History of Anatomy.*

THE day merges itself in the museful dusk, it yields to the silent caress of the claspings shadows, it permits the pensive embrace of the gentle evening.

Yet all is not dim nor darkness — there is still twilight and starlight and moonlight, and lo! from the window gleams the cheerful lamplight.

Cease to ply your tasks, O men. Follow the nearest path that leads to home. For you a flame is burning, and a loving woman waits. Do not tarry, for she expects you. If you linger she will peer with anxious eyes into the night — and see nothing. See, she keeps the supper warm, and your chair is ready. Take your place at the head of the table and sit among your family. Hasten, the darkness is deepening.

Soon the soft-shod Morpheus lowers his sable curtain, and all the world seeks its bed and travels to the City of Sleep. On the pillows of forgetfulness it lies, and covers its body with the blankets of peace. The bustle is stopped, and quarrels are over at last. Anger is gone and sorrow has fled. Now worry is routed, and misery made to halt. Here are the portals of repose; come and enter, O weeping eyes and wounded heart. Where are the tears, and what has become of pain? Ah, they enter not the beautiful land of oblivion, and of them the slumberers know naught. Soft is the air of dreamland,

and easily it is inhaled. Chant the lullaby song of rest, and raise not your mantle, O somnolent god. Over all silently waves the soundless banner of a silken calm.

Sleep on, weary world; sleep, sleep, sleep.

Refrain — for all do not sleep. The night has a life as intense as day. It is then that the humble badger comes from its burrow and the cricket chirps to its little mate. It is then that the lonely poet stands beneath the stars and frees his soul from the limitations of time and space. In the damp of the night the caterpillars crawl forth to feed on the leaves, and the plaintive whip-poor-will laments its name in sadness. Now the nightingale's golden tongue is unloosed, and like a song-intoxicated spirit it warbles a melody to the beloved and blushful rose. The solemn owl, that on the bough of the sycamore tree blinked like a fool all day, has become the king of the air and will outface the royal eagle. With a deep and doleful tone it hoots thru the silent forests, and its mysterious, melancholy voice, so ghost-like and ghastly, sends a thrill of terror thru the hearts of oak. Fearlessly outspreading its pinions it sweeps like a silence over the distant hills — the hunter of the night is after his prey.

Strange women, members of the oldest of professions, smile upon men they have not seen before. Across the way, at the next house, a faint cry is heard — a new individual has begun its existence.

The night is the time for lovers — the whole earth swarms with them. The night is their trysting-time, for they are worshippers of the moon. The night kindly hides them from the outside world, and converts every retreat into a holy place.
. . . . A little canoe glides along the placid stream
. . . . the oar ceases to be held, the unguided boat drifts with the tide . . . but think not it is empty. Arm-in-arm thru Lovers' Lane they wander; many sit at the water's edge; and there is scarce a spreading tree but shelters a youth and a maid. Into this sacred secrecy we must no longer pry, for the gentle words that are now uttered are meant for them-

selves alone and the brooding night — the night that has a romantic heart but tells no tales.

Alas! that some should wish the night to cover deeds that daylight must not see. Hark, why are the footsteps of that fellow as silent as his shadow? If he had the wings of the bat he could not sail more noiseless thru the air. The furred cat could learn from him the soundless tread. To the end of the town he walks, and e'en when the watchful dogs bark aloud he is as quiet as the swinging carcass of the convict that hangs moldering on the gibbet. Ah! save us, Virgin Mary, for thither is he bound. Stealthily he climbs the slippery steps and steals the corpse. (The moon looks calmly at his pale face.) Oh, ye blessed saints, protect us from his evil eye — it is the same youth that last week robbed the charnel house and dug the dead from their graves!

The living thief descends from the gallows and carries the dead thief on his shoulder. A figure emerges from the gloom. Heaven grant it be an officer of the law. Well, it is, but he sees nothing and passes on. The youth drags the decomposing carcass toward his home. Its odor is frightful, but it does not offend his nostrils. He clutches the decayed frame tighter, it is to him a precious thing.

At last it is safe in his own room. Impatiently the eager anatomist draws his knife and begins at once to cut the body. If he be discovered, he too may be among the dead, for the Merciful Church expressly forbids the dissection of dead human bodies, and this very year the fires of the Inquisition have saved many heretic souls by burning their sinful flesh. Aye, it would go hard for the impious youth, and rightly too, for the infallible Church has always preached that as God took a rib from Adam to make Eve, man has one rib less than woman, but since this bold blasphemer began to dissect human bodies he has discovered the untruth of this theory.

Have a care, Vesalius, or the hot flames of the Holy Inquisition will burn your own body into an ash for the winds to scatter.

Now the moon goes away, and the traveling sun comes home. The badger has returned to its hole, and the voice of the cricket is still. The poet's vision is faded, and the sorrowful whip-poor-will is silent. The caterpillar has ceased its feast, and the nightingale sings no more to the bashful rose. The helpless owl is stupid again, and weaker birds dash with impunity against his blinking eyes.

The day with all its duties has dawned, and the fond lovers have separated.

They who have done unlawful deeds by night now tremble at the blazing sun and its searching rays, but Andreas Vesalius is unafraid. This proud moment he would defy the Council, and the piled-up fagots of the dreaded Inquisition could not make him recant. In his eyes shines a light that seems to dazzle the beams of the heavenly sun itself. He, too, feels himself high . . . high . . . above all clouds. So Praxagoras must have looked and felt when first he distinguished arteries from veins, for during the night Vesalius has discovered the structure of the human heart!

Vesalius was a born dissector; as a child he cut up the bodies of mice and moles, of cats and dogs,—not for sport, but for knowledge. 'It's in the blood,' explained his mother as she watched him at work, for his great-great-grandfather had written commentaries on Avicenna, his great-grandfather taught medicine at Louvain, his grandfather was the physician of Mary of Burgundy, and his father was apothecary to Charles V.

Vesalius was a magnificent youth: he was dissatisfied with existing conditions. In his day, men learned anatomy by studying Galen, not by dissecting corpses. 'If you trust Galen, why dissect?' they asked, and since everyone believed Galen, nobody dissected. When it did become necessary to make practical demonstrations to students, the lower animals were employed, usually a pig. Human cadavera were seldom exhibited. Moreover the scholastic pedants who taught anatomy did not deign to wield the scalpel themselves; the

professor sat on an elevated seat, generally with a copy of Galen and Avicenna before him, and discussed learnedly; a demonstrator stood below, and with a long staff pointed to the organs; the dissection itself was performed by a barber.

No wonder Vesalius complained that the student learned less in an anatomical theater than a butcher might learn in his shop. He said his teacher Guinterius never used his knife for any other purpose than to cut his steak. Warm blood coursed thru the veins of Vesalius; during a demonstration, irritated at the awkwardness of the barbers, he thrust them aside and performed the dissection himself. 'By Hercules!' exclaimed Guinterius, and looked with admiration at his talented and impetuous pupil.

All this was in Paris, and Vesalius longed to be in the land where anatomy was cultivated with more zeal than elsewhere — Italy, that immortal country so often destroyed by the rapacity of ecclesiastics and diplomatists, but ever reviving afresh with new beauty.

In 1537 Vesalius saluted the Queen of the Adriatic. Between Venice and the Vatican there existed an antagonism of long-standing. When the Pope said Yes, the Venetian senators said No. In the republic of Venice no churchman was permitted to hold a civil post, and thruout the hall of the great council often rang the sentry's warning-cry, *Fuori i Papalisti*.

But Vesalius never bothered his head about such matters; osteology and myology, and not politics and theology, were his concern. The Paduans, who were Venetians at that time, soon found room for Vesalius. They created the chair of anatomy for him, and thus at the age of twenty-two Andreas Vesalius of Brussels became a professor at the University of Padua.

His enthusiasm in anatomy was infectious. When Vesalius lectured no one thought that anatomy was as dry as dust. When the young professor cut a layer to expose a muscle or a nerve, five hundred auditors — students and teachers, officials

and clerics — leaned forward with attention. No doubt the circumstance that whenever possible Vesalius adopted the novel procedure of dissecting the human cadaver instead of a pig or dog, served to add to the interest and curiosity of the spectators. The fame of Vesalius spread; other cities asked him to come and reveal to them the wonders of the human body.

He made so many discoveries that it is difficult to name them all. His researches on the vascular system were of extreme importance; he determined the position, form, and internal structure of the heart, and investigated the function of its fibers and valves. Among his other descriptions and discoveries may be mentioned a fuller account of the anatomy of the brain than had yet appeared; the first satisfactory description of the medical student's terror, the sphenoid bone, at the root of whose pterygoid process is a small aperture still called *foramen Vesalii*; the discovery of the canal which passes in the fetus between the umbilical vein and the vena cava. He showed that the sternum consists of three parts, and the sacrum of five or six. He was the first who described the omentum and its connection with the stomach, spleen and colon; the internal pterygoid muscle, the ductus venosus, the course of the vena azygos and subclavian vein, the absence of the 'rete mirabile' in the brain, the five cerebral ventricles, and the non-glandular character of the caruncles. He likewise described accurately the mediastinum and pleura, the tensor tympani muscle, the labyrinth, the vestibule of the ear and the long process of the malleus, the fornix and septum, and he was the first whose views on the pylorus have been found correct.

Many who attended his demonstration marveled at the audacity of Vesalius; he spoke of the mistakes of Galen. Hardly more than a boy in years, he was not willing to abide by the dicta of the Pope of Anatomy — isn't it glorious to be young? Galen believed there was no marrow in the bones of the hand; he believed that during parturition there is a

separation of the bones of the symphysis; he believed that the inferior maxilla consists of two pieces; he believed the ascending vena cava arose from the liver; Vesalius proved that in each instance Galen was incorrect. Vesalius showed that Galen was wrong when he assumed the existence of a general muscle of the skin, an imputrescible bone of the heart, the os intermaxillare in adults, a decided curvature to the bones of the thigh and the upper arm.

At twenty-five Vesalius decided upon a vast undertaking: he began to write a book on anatomy which he was confident would revolutionize the entire science and supplant every other text-book in existence. It was to consist of seven parts: the first was to deal with bones and cartilages, the second with ligaments and muscles, the third with veins and arteries, the fourth with nerves, the fifth with organs of nutrition and generation, the sixth with heart and lungs, the seventh with the brain and organs of sense.

Vesalius could attend to the text himself, and it seems that he even drew some of the illustrations, but still an artist was needed to make the finest figures that ever adorned a medical work. Vesalius had his troubles, and he often complained that the artists were much more interested in painting Venus than in drawing his dissected carcasses. When we remember that preservative fluids were not used in those days it is not astonishing that the Titians and van Calcars and Coriolanos found less pleasure in foul-smelling viscera than in the lively limbs of a living signorina. Vesalius was certainly exacting; at times the artist grew tired — and then curses were handed back and forth. More than once the distracted Vesalius envied the peaceful corpse that was safe from the antics of the artistic temperament. But Vesalius generously scattered money — a mystic commodity which inspires even such impractical men as artists — and the work advanced.

Such illustrations as Vesalius finally received must have compensated him for his travail. Such fine skulls and fascinating skeletons, such perfect viscera and beautiful muscles,—

strictly correct from both the anatomical and artistic viewpoints — were revelations. It is true that the unique Giacomo Berengario of Carpi — the specialist in syphilis who amassed a fortune in Rome by treating rich priests for the French evil — had also done considerable work in the line of art-anatomy, but the illustrations of Vesalius were much superior.

During the summer of 1542 a merchant on his way to Basel carried in his train bulky blocks of wood — but they were worth their weight in platinum. On these blocks was built the science of modern anatomy — they were the blocks of Vesalius' book. Vesalius had uneasy nights; he had a presentiment that the trader Danoni would not go straight to the printer Oporinus, but would get drunk on the way and lose his precious blocks; or he would be attacked by rival anatomists and the blocks would be stolen. But Danoni attended to his business and brought the blocks into the shop of Joannes Oporinus, the scholarly printer of Basel. Printing was a new art in those days, and a printer was a man of mark. Vesalius wrote to Oporinus begging him to take extreme care with his work; as Oporinus already possessed a European reputation for fidelity, he must have considered Vesalius' precaution unnecessary, but probably excused it on the ground of vanity of an author. Vesalius was nervous — he was sure that the shop of Oporinus would burn down — and he came to Basel himself to see that everything was all right.

In 1543 Vesalius' volume — magnificent in appearance, monumental in contents — came from the press. With the publication of *De Humani Corporis Fabrica* the text-books of Galen and Mondino and Guy de Chauliac became antiquated — still interesting for the historical student, but unimportant for the scientific worker. Vesalius was twenty-eight — in three years he accomplished what he had set out to do. Vesalius lived in the Golden Age of Anatomy; the greatest anatomists that ever held a scalpel were his contemporaries: Leonardo da Vinci, Cesalpinus, Servetus, Fallopius, Eustachius, Ingrasias, Realdus Columbus. But the crowning masterpiece of



VESALIUS

that brilliant period is Andreas Vesalius' *De Humani Corporis Fabrica Libri Septem*. It conferred on its author this title: Father of Modern Anatomy.

Among the lamentable facts in the posthumous history of certain eminent men is the circumstance that tho during life they sailed in the advance current of new ideas, no sooner are they dead than their followers convert them into a dam to beat back the overflowing river of progress. Thus it is that he who wished no limit to be placed on freedom, himself unwittingly becomes the clog by which men cry, 'Halt!' Disciples are a nuisance; they forget we must march on — beyond their masters. If Heine is correct in assuming that heaven is ruled by an Aristophanes, surely nothing can move him more to mirth than to reflect that a mortal who is hunted by his contemporaries as a heretic, is considered by his posterity respectable enough to blow froth from the cream-puffs of platitude.

It was a wise old man who wrote the following lines, but unfortunately such an injunction is always disobeyed:

I call to the world to distrust the accounts of my friends, but listen to my enemies, as I myself do;

I charge you, forever reject those who would expound me, for I cannot expound myself;

I charge that there be no theory or school founded out of me;

I charge you to leave all free, as I have left all free.

How vast and wonderful was the mind of Aristotle, so limitless and immortal; but as soon as his teachings were enthroned as the ultimate authority from which there could be no appeal, the great Stagirite became a wound on the breast of science which needed excision.

Galen had done mighty work for science, but his influence became positively harmful as soon as men exchanged their senses for the *ipse dixit* of the physician of Pergamus. Galen had corrected the errors of his eminent predecessors — amidst insult and abuse — but in due time he himself was turned into a veritable oracle, a god who disputed must not be,

and when after many centuries, Vesalius in his turn, with all reverence pointed out the shortcomings of the Galenian system, he made bitter enemies who struck him with stinging words.

During the sixteenth century it was sacrilege to dispute a verdict that had come out of Greece or Rome. So worshipful of antiquity was the Renaissance that when Rondelet and Pellicier, wandering thru the marshes of the Camargue, came across the pink flowers of the water-germander which corresponded to the Scordium of the ancients, all Europe applauded the botanists who found a plant that Dioscorides and Pliny had known. And when the Garum was re-discovered, — that classic sauce whose virtues Horace had sung from his Sabine farm — a flood of praiseful poetry followed.

The men of the Middle Ages could never imbibe the spirit of Greek science; they could repeat only the dry letters. They never knew Greek medicine as it really was: they were acquainted only with its caricature. The men of the Renaissance were wiser, and throwing away translations and commentaries, they studied Hippocrates and Galen and Celsus in the original. This love of the imperishable classics was fruitful in results — but evil was mixed with the good. Greek antiquity was a dream of light; medievalism was a nightmare. Nothing better could be read than the classic philosophers, and nothing worse than monkish psalters. But when the Greekophiles uttered the commandment, 'Beyond Galen thou shalt not go,' — then came the harm.

When the medieval grammarians argued technical phases of their science, instead of using elegant language, they cursed, 'May God confound thee for thy theory of irregular verbs,' and now Jacobus Sylvius denounced Vesalius as an impious madman whose breath poisoned Europe.

The life of Vesalius was a struggle against the hypnotic effects of Galen's authority. If Galen had said that a kidney is larger than the liver, men would have believed it. For example, Galen had written that our thigh-bones are curved.

Now, when even a cursory examination revealed the fact that our thigh-bones are straight, Sylvius still asserted that they were curved in a state of nature, and that their straightness was due to the narrow trousers which men wore. Galen had declared that man (irrespective of age) possessed an intermaxillary bone. Vesalius could not find it, and he said so,—he who could tell every bone in the human body blindfolded. But the Galenists refused to be convinced. A human skeleton was brought to Sylvius. ‘Where is this intermaxillary bone?’ he was asked. The faithful Galenist answered angrily, ‘Man had this bone when Galen lived. If he has it no longer, it is because sensuality and luxury have deprived him of it.’ Galen also said there is a connection between the two ventricles, and thereafter every anatomist who examined the heart saw the hole. Then Andreas Vesalius looked, and said, ‘I don’t see it.’ And he didn’t—it isn’t there.

Vesalius deserves endless credit for his criticisms. To supplant an authority is admirable. In science there should be guides, not despots; teachers, not tyrants. The great thing is, to leave all free! Let priests have their popes and bulls and dogmas, but give us the Open Road!

Since Vesalius did such glorious work in the days of his youth, it may be wondered what he accomplished during maturer years. The answer is: Nothing. His numerous enemies did not silence him, the Inquisition did not smite him in his prime, but the siren of aristocracy seduced him from science. He became the court-physician of Spain, and instead of brushing aside harmful traditions and opening up scientific vistas, he labored faithfully on the gouty toe of Charles V. He attended pompous dinners, and grew polite in manners and learned in etiquette. He was taught how low to bow to a thieving bishop, and how far to bend his knees to a luetic marquis. He took his place among the king’s dwarfs and his jesters. Yet Vesalius seemed satisfied. He took unto himself a wife, made money, and exchanged the intellectual life for the easeful one. So the years passed.

Spain was in consternation; dismay was written on the impassive Hapsburg face; alarm hung over the peninsula — as if the commons of Castile were rising again in insurrection under the leadership of young Juan de Padilla and his gallant wife. But it was no second *guerra de las comunidades* that now frightened Toledo and spread confusion thruout Tordesillas; it was a calamity of a different sort that threatened the stability of Hispania. The licentious Don Carlos had been chasing a girl, the girl ran away, Don Carlos followed, Don Carlos tripped, Don Carlos tumbled down the steps, Don Carlos broke his head. Don Carlos was not fair to look upon: he was a little fellow, with a lame leg, a crooked shoulder and a twisted brain, but he was the son of King Philip, and heir-apparent to the largest empire on the globe. If he should die, who would rule mankind? Ten days went by and Don Carlos was not yet out of danger; he breathed heavily, and developed high fever and erysipelas. The situation was critical; something extraordinary had to be done; at least that's what the Spanish physicians and prelates whispered together. From the churches of Seville and Alcala and Madrid arose prayers for the recovery of the prince. The miraculous image of the virgin of Atocha, and the bones of St Justus and St Pastor were placed upon his pillow. Philip knelt within the Jeronymite monastery, and promised God that if Don Carlos survived, he would heap gold upon every shrine in Spain. The Duke of Alva, that terrible and merciless man who crushed out the liberties of the Netherlands, remained all night at the foot of his bed. But a Netherlander also was in the room — Andreas Vesalius bent over the nasty abortion to see what science could accomplish. Even Miguel de Cerventes, in his most mocking moment, never imagined so preposterous a scene!

Vesalius received a book. It was written by a former pupil of his — Fallopius. In a leisure moment Vesalius commenced to glance thru the volume. A tinge of jealousy crept thru his veins. The Father of Anatomy read of anatomical

discoveries of which he knew nothing. While he had been dawdling away his days in the performance of petty functions, science had been advancing. Vesalius grew sad. He felt himself a Lost Leader. Old memories awoke. He remembered how, long ago, he had taught anatomy to eager students. He recalled his own enthusiasm, his disputes, his demonstrations, his discoveries. . . . Fallopius even went so far as to point out some errors that Vesalius had made; Vesalius was enraged, but the effect was wholesome. While preparing an answer to Fallopius, his better nature reasserted itself. He determined to quit the pathologic court of Spain, and once again devote himself to the pursuit of knowledge.

About this time, after an obscure illness, a nobleman died, whereupon Vesalius decided to perform an autopsy, to determine, if possible, the disease which carried off this grandee. With his skilled hand he opened the chest . . . but then Vesalius saw, and all present saw, what they had not thought to see — a beating heart. The breezes carried the unpleasant news, the enemies of Vesalius accused him of impiety and murder, and the Inquisition sentenced the great anatomist to death. (According to a less-known story, Vesalius was thus condemned because while dissecting the mistress of a priest he discovered unmistakable evidence that Christ's bachelor had not kept his vows as to chastity.) But Philip II interceded for his Archiatrus, and as the merciless monarch was influential with the merciless institution, the punishment of Vesalius was commuted to a pilgrimage to the Holy Land. There is a story that Vesalius undertook this journey voluntarily, to get rid of the vigorous tongue of his wife. In this multiplicity of versions it is difficult to reach the truth, but it is generally believed — and there is contemporary testimony to support it — that it was to escape the fires of the Inquisition that Vesalius sailed over the waters to Palestine.

Not Jerusalem is the Holy Land, not Sinai's top, nor the Mount of Olives; not the Sea of the Plain, or the Pool of

Siloam, and neither the waters of Merom nor the wilderness of Judea can claim the sacred name; neither the valley of Achor nor the fountain near Jericho, not Jacob's well nor where the river of Jordan rolls, but the land where man works for the welfare of man,—this is Holy Land.

Gabriel Fallopius died young, and the Venetian senate invited Vesalius to again fill the Paduan professorship thus made vacant. So Vesalius left the palm-trees of Cyprus and sailed to the Ionian Sea. The winds blew, the billows rose like mad, an infuriated storm broke forth, and under the blue Italian sky, on the beauteous Isle of Zante, whose laurels and myrtles have been sung by old Homer and Virgil, the anatomist was wrecked.

A wandering goldsmith entered a wretched hut and was startled to see a corpse on the floor—a corpse that Andreas Vesalius would never dissect. The winds of heaven destroyed his life, but could not wipe out the remembrance of his life-work. He perished in hunger and misery, but bequeathed to posterity an immortal name. Whenever we think of the pathfinders who advanced the progress of science, we evoke a picture of the intrepid Vesalius, knife in hand, battling against the tyranny of tradition.

(1517-1590)

PARÉ, THE SURGEON

PARÉ, THE SURGEON

Fine old Ambrose Paré, that quaint and delicious writer, the surgeon of princes, and the prince of surgeons:

—OLIVER WENDELL HOLMES.

Nor was Paré great on the positive side of progress only; he was no less resolute in confutation of fabulous lore. If he believed in his puppy dog fat—and how could he resign a secret remedy which had cost him so many prayers!—he denounced, with an audacity which in our tepid and skeptical times we can scarcely appreciate, the bogus virtues of mummy and unicorn. As great personages would marvel that he had not administered mummy in their lacerations, Paré was aroused to indite his opinion of the stuff; and the King must have been annoyed to read farther that the horn of the unicorn of St Denis, for which he had refused 100,000 crowns, was but an old woman's charm.

—THOMAS CLIFFORD ALLBUTT.

THE French were invading Turin. All armies are alike, and on their victorious way the soldiers of Francis I demolished the villas, broke the wheels of the mills, threw the nether stones in the thrifty brook, polluted the wells, poisoned the springs, staved-in the wine-casks, burnt the barns with the golden grain, and killed the cattle that fed on the fodder.

At the Pass of Suze the battle began—for the forts and trenches of the enemy blocked the way. The French gained steadily, and their foes retreated to the castle on the hill—Chateau de Villane. The conquerors followed in pursuit, and the hoofs of their horses made impressions on the wounded and the dying.

And from the dizzy precipices came another army—also greedy. Thru the reddened air swept the huge vultures, and fastening their talons in the bodies of the dead, they gorged themselves—like leeches on the neck of a full-blooded peasant-woman.

Night descended silently—like the vultures. The field was strewn with horrors.

Here was one leg all alone, still dressed in a torn trouser. One fellow had a hole in the pit of his stomach thru which the blood oozed like water from a leaking pipe. Here was a headless trunk with a smashed chest, and as something scarlet gushed from it in spurts, it looked like a staved-in wine case. Another had one eye torn out, and the remaining one beat in its socket like a battering-ram. Many tongues were enormously swollen, and hung out of the owners' mouths as if they were mad dogs. A horse cried terribly, tried in vain to rise, and fell dead, its hoofs loudly striking the ground. An officer's skull had disappeared some way, and the sensitive and delicate brain was exposed to the air.

They were piled in heaps — like logs of wood in front of a bin, only not so neatly arranged. And some of them moved like children's toys — stiffly, and without life. The broken delirious talk and the impotent cursing were heart-chilling. Blood-poisoning was setting-in. A young fellow began to dream of home — where waited a vacant chair and an empty heart. It is true that a man loves his wife when he lies wounded on a bloody battlefield. She seems to him so tender and true. In heaps, they were piled in dirty crimson heaps, and every part of the heap that was alive, suffered.

At daybreak the French again fired upon the castle. With spikes, stones and arquebuses the besieged stoutly defended their last stronghold. But one side must lose: a breach was made in the wall, and the French won the day. The ensign and captain were strangled and hanged on the battlements. All the soldiers taken alive were literally hacked to pieces.

Out of all that garrison only one was left in the land of the living. This was a little maid from sunny Italy, 'a very fair young girl of Piedmont whom a great seigneur would have.' Irresistible indeed is female beauty if even among the corpses and the carnage its power can still be felt. Thru the centuries the sweet face of this girl captive looks upon us, reminding us much of the beautiful Briseis of the *Iliad*:

Patroclus now th' unwilling Beauty brought;
She in soft sorrows and in pensive thought,
Past silent, as the heralds held her hand,
And oft look'd back, slow moving o'er the strand.

Now that the battle was over, the soldiers put away their instruments of destruction, and the surgeons took out their lancets, forceps, pliers, dilators, incision-knives, drainage-tubes, amputating-saws and cataract-needles.

With the French was a young surgeon on his first campaign. He followed the usual method of treatment—he cauterized the wounds with scalding oil. He had read carefully John de Vigo's chapter on oil of elders mixed with a little treacle. But either he was too enthusiastic in its application, or there was an unexpectedly large number of wounded, for the boiling oil gave out. The poor frightened surgeon could do nothing better than tie the bleeding arteries with a bandage—he prepared a medicament. He passed a most uneasy night, fully expecting that when he looked at his non-cauterized patients the next morning, he would find them dead from their wounds, reeking with gangrene, vile and livid like Lorenzo's face in the pot of basil. He rose earlier than usual, and vast was his astonishment on finding that those whom he had treated with the scorching oil were in great agony, suffering with severe inflammation at the edges of the wounds, while those to whom he had applied the digestive of white of egg, were quite comfortable, and had neither pain nor swelling!

Ambrose Paré had made his first discovery. 'See,' says he, 'how I learned to treat gunshot wounds; not by books.'

When Paré returned to the French capital after his first taste of war, he heard that a certain anatomist—then at the height of his fame—desired to see him. It was the distinguished Sylvius, and he invited Paré to dinner, and listened to his original views on the treatment of gunshot wounds. Sylvius was so impressed, that he gave Paré a bit of advice which sounds very modern—he told him to publish a book.

Encouragement from such a source was stimulating indeed, and when Paré was twenty-eight years of age, a volume bearing the following title appeared: '*The Manner of Treating Wounds made by Arquebuses and other Fire-Arms, and those Made by Arrows, Darts and the Like; and also by Burns Made Especially by Gunpowder.* Composed by Ambrose Paré, Master Barber-Surgeon in Paris.' A small 8vo, of 61 pages, but what an era it ushered in!

A gorgeous copy of a later edition, printed on vellum with patterns of gold, was presented to the king's mistress, Diana of Poitiers. It is claimed that the sumptuous bindings in which this un-Grecian Diana indulged are almost without parallel. Her books were marked with her favorite symbols, the lunar crescent and the bow! Evidently this brazen Frenchwoman, merely because of the accident of a name, thought herself entitled to use the emblems of that shy goddess whose undraped limbs neither god nor man could see. These were the designs, however, that she put in Paré's book, and she also interlaced a D with an H, the H standing not for Heaven or its antonym, but for her royal lover, Henri.

So Ambrose Paré was now an author, but as he had exhausted neither the subject nor himself, he went on thinking.

Ambrose Paré was the son of a valet; many of the men whose deeds are chronicled by the historian of the medical sciences, sprang from a lowly origin.

It is fortunate that Paré was not a gentleman, for at that time surgery was regarded as unfit for an *homme de bon ton*. Besides, in those days, a man who underwent an academic education was apt to be mentally ruined for the rest of his life — unless he became a rebel.

The old Greeks were too wise to separate medicine and surgery, but the medievalists could be counted upon to embrace all possible and impossible absurdities. Of course the circumstance that the Church 'forbade the shedding of blood,' *ecclesia abhorret a sanguine*, — tho its own hands were crimson — had much to do with the degradation of surgery,

but the scholastic conceits of the pedants and faculties reached such a pass that they refused to hold a knife, or perform a venesection themselves, or make a physical examination; the hand was expelled from the realm of science, and surgery was generally relegated to barbers.

Paré received no college training; the bloody battlefield was his university. He could not read Galen in the original, but he discussed a variety of injuries that were not contained in Galen, for they were caused by recently-invented firearms. The barber's boy, who from cock-crow to evening had cut hair and shaved beards and combed wigs, confesses that he was not familiar with Greek or Latin—but he understood the language of wounds.

Paré served at the wars over thirty years, and tho he was often in danger of death, and was even taken prisoner, he was never wounded. It is true that he was once poisoned, that his leg was once broken, and that he was bitten by a viper in an apothecary's shop, but these accidents occurred during the dangerous days of peace.

Probably because Paré was country-bred, he enjoyed excellent health all his long life. His flesh was heir to few ills. Unlike Boerhaave, Harvey, the Hunters, Sydenham, Linnaeus, Berzelius, and so many other eminent medical men, he did not suffer from the respectable disease yclept gout, and had it not been for the wicked little nerves of the teeth that often throbbed like sleepless imps, Paré would have been fortunate indeed. But Shakespeare's Leonatio said truly to Antonio,

For there was never yet philosopher
That could endure the tooth-ache patiently.

The love which the French army had for Ambrose Paré was of unusual and extraordinary intensity, never before or since accorded to a non-combatant, and finding a parallel only in the affection which some centuries later it bore for the Man of Destiny.

Paré's mere presence was enough to re-animate a disheart-

ened garrison, and at the Siege of Metz, when the French troops were sorely pressed and on the verge of surrender, their beloved surgeon, tho far distant, was sent for. No sooner did he appear on the ramparts than a mighty shout arose. 'We shall not die,' they cried, 'even tho wounded. Paré is among us.' They carried him off in triumph, they continued the defense, and achieved a victory. To inspire such feelings Paré must have been not only skilful, but very kind to the soldiers; a sort of Walt Whitman:

Many a soldier's loving arms around this neck have cross'd and rested,
Many a soldier's kiss dwells on these bearded lips.

In his vigorous old age, Paré wrote of his experiences at the wars: *Journeys in Diverse Places*. In them he repeats his motto, time and time again: 'I dressed him and God cured him.' The style is most admirable for clearness and simplicity, and its curious mixture of vanity and modesty makes it a rival of Pepys. This is all the more remarkable, because as a rule when physicians tackle literature, they make as poor a showing as poets would make if they attempted to perform an ovariectomy.

'I was on a rampart,' wrote Paré, 'watching the enemy pitch their camp, and seeing the crowd of idlers round the stream, I asked M. du Pont, commissary of the artillery, to send one cannon-shot among this *canaille*: he gave me a flat refusal, saying that all this sort of people was not worth to have powder wasted on them. Again I begged him to level the cannon, telling him, the more dead, the fewer enemies, which he did for my sake: and the shot killed fifteen or sixteen, and wounded many.'

To demand the death of unsuspecting idlers enjoying themselves on the bank of a stream — is not very creditable to the author of the desire. In Paré's palliation it must be argued that he lived at a time when the Christian theology was supreme, and much was heard of the wrath of God, but naught of the Brotherhood of Man. Neither from the proud-

est cathedral nor from the humblest pulpit was the grand word Humanity ever uttered. To have shown mercy to an enemy would have been the super-miracle—more wondrous than the healing of the ear of Malchus. A vivid insight into the psychology of those days may be acquired by reading one of the most remarkable works in all literature—*The Memoirs of Benvenuto Cellini*, Written by Himself.

In the sixteenth century the Supernatural Spirits were a nuisance—tho their frightened mortal contemporaries did not dare tell them so. But their fleshless arms interfered with all things, great and small. The sweetest cream they soured, the finest babies they gave the fits; they withheld the rain when it was needed, and they darkened earth and sky with eclipses; they whispered heresies into the ears of the devoutest priests, they stole into convents at night, lifted the blankets from the chastest beds, and made indecent proposals to the holy nuns, who have kindly filled volumes of sexual psychology with their erotic confessions. Bolted doors were of no avail, for unlike the humped camel, they could pass thru the eye of a needle. They were omnipotent, omnipresent, omniscient. And most mortals feared them, for not everyone could be a Luther and lambaste them with ink-bottles.

Ambrose Paré was a superstitious man: he believed in astrology, spiritism, magic, witchcraft and the royal touch; he believed that devils sent diseases, and that saints cured them; he believed that at the command of General Joshua the celestial orbs stayed and changed their courses, that because of the prayer of Elijah it ceased to rain for three years and six months, that Jesus was born of a virgin without the aid of a male, and a host of other irrational and unscientific notions which were once accepted by the shrewdest of mankind, but are now happily relegated to the unused encephalic ganglia of the intellectually inferior.

In Paré's day, embryogenesis was little studied, and teratology as a science was unknown. Nevertheless mon-

strosities, single and double, representing various degrees of congenital malformation, were known to exist, and an explanation was needed. What was the cause, they asked, of the birth of these abnormal beings — double-headed like Janus, one-eyed like Polyphemus, with webbed toes and fingers, with seven nipples, without limbs, with both sets of genitals, with three legs, with a cleft face, with the features of a pig or dog, with osseous junctions joining two monsters together? According to some, these monsters were the offsprings of women and the devil; according to others, they were the result of sodomy. Ambrose Paré did not favor the first view, and argues thus (I quote from the old English translation of 1634): ‘It is much less credible that Divells can copulate with women, for they are of an absolute spiritous nature, but blood and flesh are necessary for the generation of man. What naturall reason can allow that the incorporeall Divells can love corporeall women? And how can we thinke that they can generate, who want the instruments of generation? How can they who neither eate nor drinke be said to swell with seed?’ Paré, however, accepted the second explanation. ‘Therefore,’ wrote he, ‘in times past there have been some who nothing fearing the Deity, neither Law nor themselves, that is their soule, have so abjected and prostrated themselves, that they have thought themselves nothing different from beasts: wherefore Atheists, Sodomites, Outlawes, forgetfull of their own excellency and divinity, and transformed by filthy lust, have not doubted to have filthy and abhominable copulation with beasts. This so great, so horrid a crime, for whose expiation all the fires in the world are not sufficient, though they, too maliciously crafty, have concealed, and the conscious beasts could not utter, yet the generated mis-shapen issue hath abundantly spoken and declared, by the unspeakable power of God, the revenger and punisher of such impious and horrible actions. For of this various and promiscuous confusion of seedes of different kinde, monsters have been generated and



PARÉ

borne, who have beene partly men and partly beasts.'

The men of Paré's day were no wiser in regard to the plague. Listen again to Paré: 'The plague is a disease coming of the wrath of God, furious, sudden, swift, monstrous, dreadful, contagious, terrible, called by Galen a wild beast, savage and most cruel; the mortal enemy of the life of men and of diverse sorts of beasts, plants and trees. . . . It is a thing established among true Christians, to whom the Eternal has revealed the secrets of his wisdom, that the plague and other diseases common among men, comes from the hand of God, as the prophet teaches us: Shall there be evil in the city and the Lord had not done it? . . . So let us be agreed that the plague, and other dangerous maladies are evidence of the wrath of God against the sins, idolatries, and superstitions, which reign over the earth: as even a profane author is compelled to confess that there is something divine in diseases.' The reader may be interested to know that the 'profane author' in this case is no other than Hippocrates.

Paré himself witnessed a plague and described its ravages: 'And what is worse, in these field-huts there was that sight of the father and the mother grievously ill, not able to help their child, and they saw it smothered and bitten by wasps, and the mother to save it got up and then fell dead between her child and her husband. Again, he who has vassals, serfs or servants, is deserted by them: they turn their backs, and none dare go to him: even the father abandons his child, and the child his father: the husband his wife, and the wife her husband: the brother his sister, and the sister her brother: and those whom you think your nearest and truest friends abandon you now in the horror and peril of this disease. How many poor women, great with child, have been deserted and left to travail all alone, on mere suspicion, tho they had no trace of the plague about them — for every sort of illness, in time of plague is feared — and so the mother and the child have died together. I found on the breasts of

a woman dead of the plague, her baby still sucking the deadly poison that was soon to kill it like its own mother. Others, when the plague fell on them, were so afraid to die that they applied red-hot irons to the swelling, burning their own flesh, if by any means they might escape: others, in hope of cure, tore it out with pincers. Some in the heat and frenzy of the disease have thrown themselves into the fire, others into wells, others into rivers: men have hurled themselves out of windows, or have dashed their heads against the wall, till their brains came out, as I have seen: others have put an end to themselves with a dagger or a knife.'

Yet, strange to say, Ambrose Paré thought the God who sent the plague was the Lord of Love.

No more can dreadful words like the above be written. No more can a devastating epidemic strike terror to the heart of a civilized nation, and wipe out a million inhabitants at a blow. In 1897, the same year that Stephen Paget published his *Life of Ambrose Paré*, the preventive treatment of the bubonic plague was discovered! No more do we quake and shudder in superstitious awe. Never again will a plague stalk like a ravishing fiend thru Europe or America. We have given the plague its *congé*, and it can never return.

Ah, how much the world owes to medical science, and how little it realizes its obligations!

Paré was glad to get home from the wars. Thirty years of battle were quite enough, and it was a pleasure for the military surgeon to be again at Paris — sitting at ease before his own fireside, watching his little daughter at play, enjoying the society of his neglected wife. He could close his eyes lazily, and was in no danger of being startled by the bursting of the enemy's shell, or the groaning of an injured soldier. He could work all day on his books, and at night when his wife made the bed, he saw white sheets and pillows unstained with blood. This was an unusual luxury for Ambrose, and he slept well.

Altho Paré had been a barber-surgeon, and still knew no

Latin — the *conditio sine qua non* of a gentleman's education of those days — he gradually gained recognition as the foremost surgeon of his age. He was growing very distinguished, and his affairs were prosperous. He even dabbled in real estate successfully. Everyone, from royalty to the populace, loved him, and he found that the spreading olive-branches of Peace offered a most pleasing shade. Never again did he wish to see fields bathed in blood. He had arrived at the age when rest is sweet, and comfort the great desideratum. He liked to walk calmly thru the beloved streets of Paris, where 'his face got to be as well known as the face of the king himself, and much more welcome.'

Ambrose Paré served four kings, which led to the witty remark that the rulers of France transferred him to their successors as a legacy of the crown. One of the four was Henri II. This monarch married a woman who has left on the pages of history a little red blot that not all the bleaching power of Time can erase. She was the daughter of Lorenzo the Magnificent, the niece of Pope Clement VII, the wife of one French king, the mother of three, the mother-in-law of the loveliest of Scottish queens and of the cruelest of Spanish kings, and her own name was Catherine de Medici.

While her husband lived, she led a passive life, as her lord was under the sway of his mistress, Diana of Poitiers, but when he was killed by Count de Montgomery — whether accidentally or purposely is not known — the unchaste Diana was told to go, the son of Catherine became François II, and as he died at seventeen, having reigned seventeen months, seventeen days and seventeen hours; another son of Catherine became Charles IX, while she herself now held the reins of power in an unrelenting hand.

She knew Paré well, and as she was a good Catholic while he was a Huguenot, she once asked him, 'M. Paré, do you believe you will be saved in the next world?'

He answered: 'Surely madame; for I do what I can to be a good man in this world: and God is merciful, giving ear

well to all languages, and alike satisfied whether one prays to him in French or in Latin.' Evidently, Paré gave God credit for being an accomplished linguist.

Even in times of peace there can be excitement, and one day Ambrose was sent for — and told to hurry. He found that his patron Admiral Coligny, after leaving the Louvre and engaged in reading a letter, had been shot from a window,—with the result that his left arm was wounded, and two fingers on his right hand broken. Paré attended to the wound and cut off the broken fingers. That Coligny was one of the most upright men of a dishonest age, all French historians agree. But Coligny was the leader of the Huguenots, and therefore every Catholic was his enemy. At two o'clock King Charles IX, and the Queen-Mother Catherine de Medici came to visit the Admiral—and Gaspard de Coligny saw his murderer. Over a hundred of Coligny's friends were in the apartments,—but they allowed the cause of the hugest massacre in history to depart unharmed.

At midnight a noise was heard on the stairs. Paré, who had remained with his patient, asked, 'What is the meaning of this riot?'

A few moments later the door was burst open, and some servants of the Duke of Guise entered. One of them, named Behme, asked, 'Art thou not the Admiral?'

'Young man,' said Coligny, 'thou comest against a wounded and an aged man. Thou'lt not shorten my life by much.'

Behme plunged a tremendous boar-spear in his stomach, and then struck him on the head. 'If it were but a man!' cried Coligny as he fell, 'but 't is a horse-boy.'

From the court-yard below was heard the impatient voice of the Duke of Guise: 'Behme! hast done?' For answer, the lifeless body of the nation's hero was thrown from the window. It fell at the feet of the waiting Duke, who kicked the bleeding corpse in the face.

It had begun — the flood of blood was loose — the greatest

massacre in French history had its scarlet baptism. Thousands and thousands of Huguenots were murdered, the streets of Paris were overcrowded with corpses, the provinces were likewise full of bodies, and the waters of the Seine were red for days after. Never can the memory of this butchery be wiped out, never can the Massacre of Saint Bartholomew be forgotten. The blood that was shed that day refuses to dry.

After Catherine induced her son to consent to the butchery, the king desired to destroy every prominent Huguenot in France, with the single exception of Ambrose Paré. He commanded Paré to repair to his own chamber, and the king himself saw to it that no zealous Catholic harmed his surgeon. The king ordered him not to stir from his wardrobe, saying it was not reasonable that one who was able to be of service to a whole world, should be thus massacred. Ambrose Paré did not even protest against the murder of his compatriots — for in those days a king ruled by divine right and could commit no wrong.

How many were massacred? Who could count? The number does not matter; the important thing is to remember to what lengths theological bigotry can go. And behind it all loomed a humble religious woman who never missed mass — Catherine de Medici. She who had asked Paré if he expected to be saved, instigated the Massacre of Saint Bartholomew.

The victress could not keep within her rooms. As some women love to walk among their roses, she now strolled among her corpses. She found pleasure in again visiting Coligny; this time he was hanging on a gibbet. The city after the massacre seemed to call her with an enticing voice — as far as the eye could reach it feasted on the carcasses of heretics. The sight of a man, naked as well as dead, brought to those pious lips a jest, vilely obscene. She had laid her plans craftily and well; she was amply satisfied. Niccolo Macchiavelli's diabolical treatise, *Del Principe*, had found its most brilliant exponent.

As for Ambrose Paré, he had seen more blood in one day at Paris than in his thirty years at the wars.

A few days after the massacre, the king said to Paré: 'Now you really must be a Catholic.'

'By God's light,' answered Paré, 'I think you must remember to have promised me never to ask me four things: never to return to my mother's womb, never to fight in a battle, never to leave your service, and never to go to mass.'

'Ambrose,' said the king, 'I don't know what has come over me for the last two or three days, but I feel my mind and my body greatly excited, in fact, just as if I had a fever; meseems, every moment, just as much waking as sleeping, that those massacred corpses keep appearing to me with their faces all hideous and covered with blood. I wish the helpless and the innocent had not been included.'

The young man should have gone to his mother — she felt no qualms. Truly, the fate of heretics was not calculated to disturb an orthodox conscience. When the tale of the crimson carnival was bruited abroad, the Pope rejoiced, the Duke of Alva laughed, and Philip II ordered all churches in Spain to peal forth pæans of praise, to ring out *Te Deum*. But two centuries later, Voltaire, whom all religionists abhor, wept a poem of pity. Modern Catholics have grown ashamed of the papal hilarity, and attempt to deny it, but —

The moving Finger writes — and having writ,
Moves on; nor all your piety and wit,
Shall lure it back to cancel half a line,
Nor all your tears wash out a word of it.

So many thousands slaughtered, and all in vain. For one young Huguenot, a pupil of Coligny, narrowly escaping with his life, lived to become Henry of Navarre, and eighteen years after the massacre he led the Huguenot forces to victory over the Catholic League at the battle of Ivry, and later established the Edict of Nantes which proclaimed religious liberty thruout the land:

Oh! how our hearts were beating, when, at the dawn of day,
We saw the army of the League drawn out in long array;
With all its priest-led citizens, and all its rebel peers,
And Appenzel's stout infantry, and Egmont's Flemish spears,
There rode the brood of false Lorraine, the curses of our land,
And dark Mayenne was in the midst, a truncheon in his hand;
And as we looked on them, we thought of Seine's empurpled flood,
And good Coligny's hoary hair all dabbled with his blood;
And we cried unto the living God, who rules the fate of war,
To fight for his own holy name and Henry of Navarre.

Hurrah! the foes are moving. Hark to the mingled din
Of fife, and steed, and trump, and drum, and roaring culverin!
The fiery Duke is pricking fast across St. André's plain,
With all the heirling chivalry of Guelders and Almayne.
Now by the lips of those ye love, fair gentlemen of France,
Charge for the golden lilies now upon them with the lance!
A thousand spurs are striking deep, a thousand spears in rest,
A thousand knights are pressing close behind the snow-white crest;
And in they burst, and on they rushed, while, like a guiding star,
Amidst the thickest carnage blazed the helmet of Navarre.

Now, God be praised, the day is ours! Mayenne hath turned his rein,
D'Aumale hath cried for quarter, the Flemish Count is slain,
Their ranks are breaking like thin clouds before a Biscay gale;
The field is heaped with bleeding steeds, and flags and cloven mail;
And then we thought on vengeance, and all along our van,
Remember St Bartholomew, was passed from man to man;
But out spake gentle Henry then, 'No Frenchman is my foe;
Down, down with every foreigner, but let your brethren go.'
Oh! was there ever such a knight in friendship or in war,
As our sovereign lord, King Henry, the soldier of Navarre.

After the battle, the gallant chieftain closed in upon Paris,
and besieged the city. But the Catholics swore to die rather
than submit to a Huguenot—and they kept their word.
While the people were eating the filth that they picked from
the gutter, devouring the bodies of the slain and chewing the
bones of the dead, the priests put on armor and threatened to
hang all who spoke of peace—and they kept their word.

But again there was one exception—Ambrose Paré was
spared a second time. Stepping out from his house one day,
the venerable surgeon found himself face to face with the
leader of the League, the powerful Archbishop of Lyon.

The prelate had intended to cross the Pont Saint Michel, but found his way blocked by a starving mass of moaning wretches.

‘Monseigneur,’ cried Paré, ‘this poor people that now gather around you are dying of the cruel pains of famine, and they ask pity of you. For God’s sake have pity on them if you wish God to have pity on you. By your high office, and by that power which we all know you possess, bring about peace for us, and give us a way of living, for the poor are now utterly helpless. Do you not see that all Paris is dying, because of the villains who prevent peace? Set your whole heart against them, Monseigneur; take in hand the cause of this desperate people, and God will bless you and repay you.’

The astonished Archbishop returned no answer, but walked away. Ambrose Paré was an aged man, and within a few months was to take his departure from life. This is the last time that we see him upon the stage of history, but we are thankful for the glimpse which exhibits to us the military surgeon raising his voice aloud for peace.

But now let us look backward, and name the books he wrote, and briefly sum up his life work. In 1545 he published his first book on the advice of Sylvius, as we have already mentioned. It was dedicated to M. le Vicomte de Rohan. In 1550 he published *A Compendium of the Chief Facts of Anatomy*, which contained also a treatise on Obstetrics. The *Compendium* was written as the result of dissections made at the School of Medicine with Thierry de Hery, who was famous even at this early period as a ‘specialist in syphilis.’ This book, like the first, was dedicated to M. le Vicomte de Rohan. In 1551 appeared the Second Edition of his first book, this time with a dedication to the King. In 1561 he published *Wounds and Fractures of the Human Head*. It contained illustrations of the instruments and a portrait of Paré. It was probably occasioned by the death of Henri II, whose case it recounts at length. The dedicatee was Chapelin. This year saw also the publication of his *Universal Anatomy*

of the Human Body. It contained Paré's portrait, and was written as the result of dissections at the School of Medicine with Rostaing Bignosc. It is very interesting to note that many of the illustrations were taken from Vesalius, whom, by the way, Paré had probably met at the death-bed of Henri II, for Philip had sent his great anatomist there. In 1568 was published Paré's *Ten Books of Surgery*. It contained portraits and illustrations, and was dedicated to the king. This year likewise saw the appearance of his *Treatise on the Plague, Smallpox, and Measles*. It contained also a short account of Leprosy. It was written at the request of Catherine de Medici, and dedicated to Castellan. In 1572 he published *Two Books of Surgery*. No copy of this edition is known to be in existence. The next year he published also a surgical work, dedicated to M. le Duc d'Uzes. In 1582 he published *On Mummy and Unicorn*, in which he wisely and vigorously attacked these worthless drugs which were then supposed to be a panacea for all ills, a sort of forerunner of Peruna. How Paré discovered they were humbugs is not known. Probably the mummy and the unicorn failed to cure his toothache. The book was dedicated to M. des Ursins. It will be noticed that the Dukes and Viscounts to whom Paré dedicated his books, tho great guns in their day, are now not even toy-pistols. Oho, for the whirligig o' time!

Four editions of the Collected Works of Ambrose Paré appeared during his lifetime: in 1575, in 1579, in 1582, in 1585. The third edition was in Latin, the translator being Jacques Guillemeau. When the reactionary mummies who comprised the Paris Faculty heard that a Latin translation was made by one who was not a member of their body, they were sufficiently enlivened to meet in council and pass this resolution: 'Since there is nobody but a member of the school who would know how to make the translation, it is disgraceful to leave it to over-presumptuous surgeons, incapable of writing a page of Latin.' A committee was appointed, and it actually acted; within nine days it suggested a title for

Paré's works, and savagely decreed that 'any leaves of the book having upon them any other title but this, to be effaced, torn up, and kept for some vile purpose.' But Paré only laughed at their confounded nonsense; for years he fought valiantly against the Faculty, and aimed many a shaft at its contemptible dean, Estienne Gourmelen:

'Let me say,' wrote Paré, 'you are like a young lad of Low Brittany, who asked leave of his father to come to Paris. When he had come, the Organist of the Church of Our Lady found him at the Palace Gate, and took him to blow the organs, and there he was three years. He sees he can speak a little French, and goes home to his father, and tells him he speaks good French, and moreover knows how to play well on the organs: his father received him very joyfully, that he was so clever in a short time. He went to the Organist of their great church there, and prayed him to let his son play on the organs, so that he might know whether he were a skilful master as he said: which the Master Organist granted willingly. Being entered into the organs, he cast himself with a great leap at the bellows: the Master Organist bids him play, and he himself would blow the bellows. Then the young man tells him, I know nothing else but only how to play on the bellows. You too, *mon petit Maistre*, I think you know nothing else but how to chatter in a Chair; but as for me, I will play upon the keys, and make the organs sound.'

In most respects Paré was ahead of the surgical knowledge of his day, but not in all. For instance, while his contemporary, Gaspardus Tagliacozzi, was developing the important art of Plastic Surgery, Paré pooh-poohed it, but many a man to-day considers rhinoplasty the most blessed of sciences.

The name of Paré has gone to the ends of the earth because of his advocacy of the ligature, but he was not its discoverer, for Hippocrates knew of it, and Hippocrates lived 460-357 B. C. 'Say what you will,' said Emerson to his philosophic readers, 'you will find it all in Plato.' Say what you will, my medical friends, let your laboratories turn out

a new discovery every time a liquid filters thru a funnel; announce a modern theory every time a patient has a fever; talk of rational therapeutics, dietetics, massage, sanitation, the value of rest, clinical observation, mental suggestion, anything you like,—and you will find it all in Hippocrates.

Paré had reached the conclusion that since ligatures were applied to veins and arteries, there was no reason why they should not be equally used in amputations. At the siege of Danvilliers he determined to test his theory on a combatant whose leg was shattered by a ball from the fortress. Paré performed the amputation, but instead of searing the stump with the red-hot iron — and there were no anesthetics in those days — he employed the ligature, to the contentment of his patient who enthusiastically declared that he had got rid of his leg on very good terms. This is perhaps the most famous operation in the entire history of surgery.

Paré was a prominent adherent of massage — that delightful system which was known in the days of Homer, when the beautiful women rubbed the weary limbs of the Grecian warriors.

Gentleness was not a conspicuous feature of the Dark Ages: in operating for hernia, hydrocele and sarcocoele,—altho the Roman Celsus knew better — it was habitual for the medieval surgeons to cut out either one or both testicles. Franco and Paré protested against this barbarity.

On the question of quiet, Paré has written so admirable a passage that I quote it for the benefit of Mrs Isaac L. Rice and her worthy Anti-Noise Society: 'The patient must be in a place of rest, as far from loud noise as possible, far from church bells, not near a farrier's, a cooper's, carpenter's, or armourer's shop, or the traffic of carts or the like, because noise increases pain, fever, and other complications.'

Paré recommended for spinal disease two plates of iron, a posterior and an anterior one, fastened together in the form of a cross. It is thought that his corset was the earliest splint intended to be worn for diseased spine.

Paré was among the first to demonstrate that gunshot wounds are not poisonous, and he held that the air itself is beneficial rather than deleterious to the injury, but that it was the *miasms* in the air which often converted hospitals of the sick into morgues of the dead.

Paré was eminent as a syphilologist: he employed the speculum for examining vaginal and uterine venereal affections, discussed the nature of syphilitic bubo, and made the first detailed communication of hereditary syphilis.

Paré advanced the art of obstetrics to a considerable extent, wrote on the subject, and restored the podalic version. In this reform of midwifery, his pupil and son-in-law, Jacques Gilleméau, was associated with him and won considerable fame.

The Leaning Tower of Pisa is secure, but the life of man passes away in a night. Only a short time ago I began to write the first pages of this sketch, and the medical historian Johann Baas was in the land of the living; now I am approaching the end of my little essay, but Johann Baas has already joined the great physicians whose deeds he chronicled. But on the bookshelf still remains his *History of Medicine*. This is what he wrote of the achievements of Ambrose Paré: 'He discarded the frequent dressing of ulcers, and castration in the so-called radical operation for hernia. He performed herniotomy in strangulated herniæ (most probably only at the suggestion of Franco), tho this operation was often performed too in his day by itinerant herniotomists. He was the first surgeon to habitually employ trusses, tho this instrument was already known to antiquity. Paré also taught how to recognize induration of the prostate and fracture of the neck of the femur. He introduced the operation of staphyloplasty and an improved method of trepanning with the crown trepan, and invented numerous instruments including feeding bottles for artificial nourishment. He performed bronchotomy, and employed the ligature in the treatment of fistula in ano; healed wounds of the nerves; circumscribed the employ-

ment of the actual cautery, particularly in operations for cancer of the breast; revived the operation for hare-lip with the figure of 8 suture, in which he was the first to follow the Arabians and Pfolspeundt; was the first to perform direct excision of the so-called loose cartilages in the joints, and was also acquainted with abscesses of the liver resulting from injuries of the head. Paré likewise improved the medico-legal doctrine of mortal wounds, practiced amputation of the leg at the point of election, and taught version by the feet.'

It was the custom in Paré's day for members of the healing art to keep secret all their discoveries. Paré did not follow these egotistical ethics, saying the 'light of a candle will not diminish, no matter how many come to light their torches by it.' In fact, he had a passion for publishing, a naïve delight in announcing his newly-acquired knowledge. On one occasion he got a remedy from a quack, and gave for it enough velvet to make a pair of breeches, and a promise of secrecy. Paré soon published the prescription, and argued as follows: 'And if any should urge that I have broken my promise to this alchymist, I answer that since he had sold it to me it was mine; and anyhow I think I have done him no wrong; on the contrary, he and I between us have conferred a great benefit on the public.' Such a passage exhibits old Ambrose Paré in all his childish sweetness and simplicity, but it is evident that he never studied the law of contracts.

Some geniuses are so abnormally modest that tho often over-appreciative concerning the works of others, it is impossible for them to realize the value of their own accomplishments. However, not many great men are thus afflicted. Merit and Modesty are not such inseparable twins as is often supposed. Ennius announced, 'Let no one weep for me, or celebrate my funeral with mourning, for I still live as I pass to and fro thru the mouths of men'; while even Ovid can hardly be accused of literary diffidence when he proclaims, 'I have completed a work which neither the anger of Jove, nor fire, nor steel, nor consuming time will be able to destroy. I

shall be raised immortal above the lofty stars, and indelible shall be my name. I shall be read by the lips of nations, and thruout all ages shall I survive in fame.'

Paré was not one of those who minimized the results of their own labors. 'God is my witness,' he says, 'and men are not ignorant of it, that I have labored more than forty years to throw light on the art of surgery and to bring it to perfection. And in this labor I have striven so hard to attain my end, that the ancients have naught wherein to excel us, save the discovery of first principles: and posterity will not be able to surpass us (be it said without malice or offense) save by some additions, such as are easily made to things already discovered.'

Truly a bold prophecy, which we must challenge. Let us look at it fifty years after it was made: is it true? Yes, true. One hundred years later—and the proud words cannot be gainsaid. Still fifty years, and still the prediction cannot be controverted. Two hundred years pass—what now? Bravo, Paré, after two centuries to be still in the van! Another fifty years roll by,—what then? What then?—why, antiseptics and anesthetics are discovered, and Paré's boast is utterly wiped out. Scratch out his passage with a triumphant hand. We surpass him a thousand times and more! That which he never even dreamed of in his most buoyant mood has been accomplished in reality.

Ambrose Paré is no longer on the skirmish-line of surgery, fighting the advance battle for the alleviation of suffering. But tho his children have gone so far beyond him, they follow the trail that he broadened and blazed, and Ambrose Paré ever remains the beloved Father of Modern Surgery.

(1742-1786)

SCHEELE, THE APOTHECARY

SCHEELE, THE APOTHECARY

It is not merely as an investigator and discoverer, but as a high-principled and unassuming man, that Scheele merits our warmest admiration. His aim and object was the discovery of truth. The letters of the man reveal to us in the most pleasant way his high scientific ideal, his genuinely philosophic temper, and his simple mode of thought. 'It is the truth alone that we desire to know, and what joy there is in discovering it!' With these words he himself characterizes his own efforts.

MEYER: *History of Chemistry*.

We may regard Scheele not only as having given the first indication of the rich harvest to be reaped by the investigation of the compounds of organic chemistry, but as having been the first to discover and make use of characteristic reactions by which closely allied substances can be detected and separated, so that he must be considered one of the chief founders of analytical chemistry.

ROSCOE: *Treatise on Chemistry*.

WHAT a strange creature Poetry chose for her prophet — a blind man who begged his bread thru seven towns.

But was not Philosophy's founder similarly bad — a bow-legged, bald-headed fellow, with goggle eyes and a sunken nose, who displeased the authorities and drained a cup of hemlock?

And I fear that Science has been equally amiss, for the father of Pharmaceutics was a poor invalid, who passed his days in debt, and died young — dreaming of test-tubes.

Yet gibe not at these men. The centuries uncover to them. Where are the towns that refused food and welcome to the inspired singer? They are blotted from the map, and if they still linger in the memory it is only because their unworthy streets were once trod by the feet of the poet.

Does the courthouse in which it was decided that the philosopher must quench his immortal thirst with hemlock, still dare to stand? No, but the bust of the intellectual martyr adorns the niches of a thousand museums.

And that little drug store out in Sweden that couldn't pay its expenses has taken off its sign, but the experiments which the chemist performed in that obscure village will never be removed from the sanctuary of science.

Places are swallowed up, cities disappear, nations decay and kingdoms perish, but an unusual man marches thru the aisles of the ages, never to be lost.

Amebæ may be identical, but the minds of men differ; Keats had the poetic instinct, and Scheele the scientific spirit.

Keats was apprenticed to an apothecary, but he cared more for poems than pills, and sometimes when he mixed an ointment there came to him a sunbeam with fairies floating in the ray. He was a child of Apollo, not Æsculapius, and the lustrious parent claimed his favorite son. The pestle was not for the fingers that held poesy's pen, and he exchanged the gallipots of the counter for the galaxy of the heavens, and instead of the dried remains of collected beetles, he searched for the iridescent butterflies that shake their damask wings among the morning-glories.

Scheele was sent to a school of languages, but he was more interested in acids than ablatives, and the miracles that take place in a test-tube had for him an awful fascination. And soon in Bauch's drug store was a new clerk, aged fourteen. Little Karl Scheele had begun to rinse bottles, and to wipe the dust from the jars that were seldom used. He removed all dirt from the stem of the funnels, and when he cleaned the metal mortars their polished surfaces reflected back his earnest features. And he told his brothers and sisters all about it, for his parents had ten children besides himself, but what their names were we really do not know.

Scheele's original work was done mainly at night. It was then he saw what was never seen before. When the moon glorified the firmament, and a thousand starry orbs looked out, strange power came to him, and he planted his foot on untrodden ground. In his skillful hands the crucible became a sesame that unlocked the door of nature. His spatula was

a magic wand that brought forth unknown things. He filled his capsules with the powders of research. His tongs pulled hot coals of fact from the boiling caldron of knowledge. With the bellows of reason he fanned the fires of truth. When his condenser was heated with experiment, it was discoveries that distilled over. Hark, how the midnight was startled by the bubbling of Scheele's alembic!

There came a time when physics no longer ministered to the ailing body of the apothecary of Koping. Purges were tried, but without avail; balsams and liniments helped not, and he went to the land where prescriptions are neither prescribed nor dispensed. Yes, he died, leaving a drugstore and a widow; and Scheele wanted both of them. He bought the former, and hoped to acquire the latter when circumstances permitted. (To-day his statue stands at Stockholm, but in those days he couldn't pay his bills.) Business was bad, and it was only several years later that they married. And such a marriage — with Death for the priest!

Science seemed jealous that this man should take another mistress, and two days later he died. He had no children — so all chemists could call him father. Perhaps it is better so. Like so many other great men, he might have become the sire of pigmies. Intellectual giant that he was, from his loins might have sprung a race of dwarfs. Aurelius was noble, his son was a monster; Cromwell was mighty, his child was a weakling; Goethe was everything, his offspring was nothing. Heredity is a humbug — often.

In estimating Scheele's work we must bear in mind that in his day chemistry had just thrown off the fantastic garb of the alchemists and was hardly accustomed to the scientific clothes which it had lately donned.

It is true that among the contemporaries were great-brained workers like Black, Bergmann, Cavendish, Priestley, Rutherford, and Lavoisier; that 'the subtile science of holy alkimy' was dead among enlightened men; that the Universal Solvent was forgotten and the Philosopher's Stone unsought for; that

he was never asked to compound the following prescription: 'Calcine vitriol until it becomes yellow, add mistletoe, hearts of peonies, elk's hoofs, and the pulverized skull of a malefactor; distill all these dry, rectify the distillate over castoreum and elephant's lice, then mix with salt of peony, spirit of wine, liquors of pearls and corals, oil of aniseed and oil of amber, and digest on a water-bath one month.'

Still at this time Chemistry stood only on Mount Abarim and gazed at the Promised Land which it was not to enter until the ensuing century.

To-day we know about eighty elements; he knew about fifteen.

In Scheele's day fire was procured by means of flint and steel with tinder-boxes and sulphur-tipped splints of wood. It was forty years after his death before the first friction matches were invented by the English druggist, John Walker, of Stockton-on-Tees.

Only after his body had turned to dust, was gas used for lighting, was the hydraulic press patented, was the Voltaic pile made, was electro-magnetism discovered, was the lime-light of Drummond invented, and the Daguerreotype process introduced.

Scheele died in 1786, and it was not till the beginning of the nineteenth century that Dalton announced his atomic theory and formulated the law of definite proportions which became the immediate cause of innumerable discoveries. Mendeleyeff's important system, in which it is shown that the properties of the elements are periodic functions of their atomic weights, came much later still.

In 1805 Sertürner discovered the basic constituents of opium, and thus paved the way for the alkaloids, but Scheele never heard of morphine, strychnine or quinine.

By means of the galvanic battery, Humphry Davy did wondrous things — he discovered element after element, he decomposed water into hydrogen and oxygen, he separated salts into acid and base, he resolved acids into their electro-positive and

electro-negative constituents, he simplified bases into the metal and oxygen,—but there was no voltaic chemistry while Scheele lived.

Michael Faraday began systematic work in the liquefaction of gases and liquefied chlorine, hydrogen sulphide, cyanogen, ammonia and sulphurous acid. On December 24, 1877, at a meeting of the French Academy a paper by Cailletet was read containing these welcome words: 'I have just this day liquefied oxygen and carbon monoxide.' There was another paper by Pictet announcing: 'To-day I liquefied oxygen at a pressure of 320 atmospheres and a temperature of -140° C, obtained by means of liquid sulphurous and carbonic acid.' The patient Dewar succeeded in securing obstinate hydrogen not only in a liquid but even in a solid state. Mighty deeds; Scheele's heart would have leaped at them, but he never knew.

Nor did he ever know that urea, an organic body, could be produced artificially in a laboratory.

Scheele had not the hundredth part of the delicate and intricate instruments with which the chemist of to-day is supplied. His apparatus was of the crudest sort, and much of it he was compelled to manufacture himself. He never saw a polariscope, or a balance which weighed a pencil-mark. Had he seen a laboratory like Sir William Ramsay's, his actions would have resembled those of his great countryman, Linnæus the Botanist, when he first spied an English wild-flower, — the earth would have felt his knees.

When we remember these hardships and at the same time recall the immense amount of valuable work he accomplished, we realize what manner of man was Scheele. The pioneer who blazes the trail in an unknown forest, surely deserves as much credit as he who comes leisurely after and helps to widen the already-made path. If the second is the more cultured of the two, he is the less original.

Because of Scheele's devotion to it, mention must here be made of one of the most interesting hypotheses that ever en-

tered into the history of chemistry—the Phlogistic theory. This doctrine which was introduced by Johann Joachim Becher and championed by George Ernst Stahl had special reference to the alterability of substances by fire. Its essential feature consisted in assuming that all matter which could burn was a compound, containing at least two constituents. On combustion, one of these remained behind and one escaped. The element which remained was named calyx, the principle which disappeared was called Phlogiston. It corresponded somewhat to the ‘celestial heat’ of earlier chemists. Since this Phlogiston existed in all combustible substances and always vanished on heating, it was believed that every time a substance was burned it grew lighter.

In due time it began to be pointed out that some substances when heated, instead of becoming lighter, become heavier, and that often the products of combustion weigh more than the substances burned. It was shown that when zinc is burned, it changes into a white powder which is heavier than the original metal.

Lavoisier knew that when phosphorus burns, the acid body formed by the combustion weighs more than the phosphorus did. But it takes a long time for a naked fact to destroy a theory intrenched in argument, and defended by dialectics. Yet already the casket of Phlogiston was being prepared, and Lavoisier was the immortal undertaker.

Oxygen was discovered by Priestley and Scheele, nitrogen was found by Rutherford, the air was analyzed by Cavendish, and a great light illumined the mind of the French chemist, and the death-knell of the doctrine of Becher and Stahl was rung. Hitherto, combustion was thought to be due to a chemical decomposition in which Phlogiston escapes, but Lavoisier now accounted for the phenomenon of combustion by chemical combination, oxygen or another element being taken up.

The cover was ready to be nailed to the coffin. And the talented wife of Antoine Laurent Lavoisier,—Liebig has told

us so,—robed as a priestess, committed to the flames on an altar, while a solemn requiem was chanted, the phlogistic system of chemistry.

After Copernicus there was no more excuse for astrology; after Darwin there was no more reason for immutability; and after Lavoisier there was no further justification for Phlogiston. But the roots of pre-conceived notions are long and strong, and take generations to uproot. Only one chemist of that age accepted the new truth. Sole among contemporary scientists, Joseph Black—forever illustrious as the discoverer of latent and specific heat—announced himself an adherent of the Lavoisierian doctrine of combustion.

Priestley, Cavendish and Scheele remained firm believers in the phlogistic theory which their researches had done so much to upset.

So Scheele was wrong, but what scientist has made no mistake? Galileo discovered a new heaven, but he laughed when Kepler claimed that the tide is influenced by the moon. Harvey discovered the circulation of the blood, but he saw no merit in Bartholin's researches on the lacteals and lymphatics. Perhaps we must say of these men as Carlyle said of Jesus, 'A great mon, a great mon, but he had his limitations.'

Science has a sorrowful list of wondrous youngsters who disappeared from life when the brain was still eager, and the spirit ardent. Scheele was one of these. In his forty-fourth year he was added to the roll of short-lived geniuses. Yet tho the days of his life were few, he labored long and lovingly, for he was in the service of science, and some of the benefits he rendered her are here recorded:

In 1769, while still in his twenties, he experimented with cream of tartar, from which compound he was the first to isolate tartaric acid. He sent a record of his experiments to Torben Bergmann, the foremost Swedish chemist. The professor was a generous friend, but at this time must have been absorbed in his own work, for he failed to convey the paper

to the Academy of Sciences at Stockholm, which, however, was later done by Anders Retzius.

As far back as 1669 the alchemist Brandt of Hamburg, while searching for the 'philosopher's stone' that converts lead to silver and ennobles brass to gold, distilled an evaporated mixture of urine and sand, and obtained, not the 'elixir of life,' but — phosphorus. This yellow waxy solid which shone so mysteriously in the dark, and burned with such a dazzling light, was exhibited in the courts of Europe and attracted the attention of lords and ladies who had never previously evinced a startling congenital predisposition for scientific pursuits. Phosphorus is used in medicine as a sexual aphrodisiac, and it would be interesting to know if it was the Merry Monarch and his royal revellers who discovered this therapeutic fact.

For a hundred years the peculiar phosphorescent element remained a chemical curiosity, costing about sixteen ducats an ounce. But in 1771 Scheele — building on Gahn's observation that phosphorus is a constituent of bone-ash — published a method still used in preparing the light-bringer. Bones are burned to remove all animal matter, and the remaining calcium phosphate is heated with hot sulphuric acid, producing phosphoric acid and calcium sulphate. The acid is then strained from the sulphate, concentrated, mixed with charcoal, and dried in an iron pot. Water escapes and metaphosphoric acid remains. The mixture is then transferred to a fireclay retort, strongly heated, and under the water appears the desired phosphorus.

Its principal modification is the red or amorphous phosphorus discovered by Professor Schrotter, of Vienna. Altho prepared from the yellow variety, its properties are essentially opposite. It is practically odorless, non-poisonous, non-phosphorescent, insoluble in carbon disulphide, non-decomposable in the air.

Both the yellow and the red phosphorus are employed in the manufacture of matches. Sweden is the world-leader in



Painted for Pathfinders in Medicine

SCHEELE

this instance, and exports yearly, we suppose, about one hundred billion of these fire-tipped splinters.

The ordinary match which we buy at the grocery stores is made by dipping the wooden sticks — impregnated with paraffin or sulphur to sustain combustion — in a warm adhesive agent containing an emulsion of yellow phosphorus as the oxidizable constituent, potassium chlorate and manganese dioxide as the oxidizing components, and powdered glass as the frictional element.

Such a match is a remarkably convenient article, as it can easily ignite on the sole of a gentleman's shoe or the back of his trousers. The splint may be broken, but as long as he can find the head at the bottom of his pockets he carries with him the conscious power to set clouds of happy smoke curling from the burning altar of Nicotia.

Unfortunately this match is a menace to safety; it starts innumerable accidental fires, and children die from sucking and chewing it. It will be recalled that Longfellow's first wife, clothed in a light summer dress, happened to step on one of these matches which instantly fed upon her garments and burned her to death.

The Swedish sulphur match is free from this disadvantage, and can be stepped on with impunity, but children should not be encouraged to use it as a substitute for caramels. The head contains potassium chlorate, potassium dichromate, red oxide of lead and antimony sulphide. The oxidizable material on which the match ignites is on the sides of the box, which consists of red phosphorus, antimony sulphide and powdered silica.

In 1771 Scheele investigated the composition of fluospar and noted that the property of etching glass when mixed with sulphuric acid was due to the formation of an acid which he called fluor acid. Scheele's operations had been conducted in glass vessels and what he really obtained was fluo-silicic acid.

In 1774 Scheele showed the difference between pyrolusite

(manganese dioxide) and magnetite, which previous chemists had considered identical.

He explained how manganese colorizes and decolorizes glass, and distinguished the salts of the lustrous metal, including the green and purple compounds with potash. In fact, he may be considered the discoverer of this element.

In this year he also discovered baryta (barium oxide), a heavy, whitish-gray, poisonous compound, used for plate-glass manufacture, in color-making, and in the preparation of oxygen by the Brin process.

This should have been enough for one year, and Scheele ought to have remembered that Nature herself sleeps half the time, but instead of that he discovered chlorine by treating manganese dioxide with hydrochloric acid.

Scheele thought this gas was a compound and called it dephlogisticated muriatic acid. Its elementary character was established in 1810 by Davy. He named it chlorine on account of its greenish color.

Nor was this all, for this self-same fertile year saw his discovery of oxygen — independently of Priestley's revelation — by heating manganese dioxide to redness in an iron or clay retort.

Subsequently Scheele found an improved method of obtaining this gas — by heating manganese dioxide with sulphuric acid. When manganese dioxide is heated alone, 100 grams of it yield 8.51 liters of oxygen; but when treated with sulphuric acid, 100 grams produce 12.82 liters of oxygen. The reaction is now familiar to every novice, and medical and pharmaceutical colleges ask it in the early quizzes.

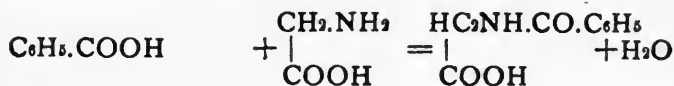
He shrewdly speculated as to its function in respiration and the growth of plants, and computed the amount of oxygen in the air correctly. The term oxygen (so named by Lavoisier) means 'acid producer' and is therefore a misnomer, as all acids do not contain oxygen. Hydrogen should be called oxygen, because all acids contain hydrogen.

Previous to the discovery of oxygen, Professor Daniel

Rutherford of the University of Edinburgh, observed that by absorbing the carbon dioxide produced by respiration in an enclosed volume of air, the remaining gas would support neither combustion nor respiration. But it took a long time for scientific news to reach the sequestered (to use Washington Irving's favorite adjective) Swedish town in those days, and just as Scheele had discovered oxygen independently of Priestley, he also discovered nitrogen without knowledge of the Scottish naturalist's observation. Scheele was the first then who demonstrated, by analysis and synthesis, that the air consists mainly of two gases, one supporting combustion and the other preventing it.

The year 1775 was as stirring for Scheele as it was for the English colonies in America. The price of potash salts was increasing enormously, and attempts were made to produce the carbonates from common salt. The French Academy of Sciences offered 2,400 livres to any one who would succeed in converting salt to soda. Scheele at once solved the problem, and made soda from salt by means of litharge. Did he use the much-needed prize-money for the purpose of ——— ? Ssh! your hand to your ear, promise not to tell, and we'll whisper you a secret: He received not a sou.

Scheele separated benzoic acid from benzoin by combining it with a salifiable base and precipitating it with an acid. Later Scheele prepared it from urine by the decomposition of hippuric acid. When benzoic acid is taken into the system, it unites with glycocin with the elimination of a molecule of water, and is excreted as hippuric acid. We have thus an excellent instance of synthesis performed in the marvelous laboratory of the human body, which needs no Friedrich Wöhler:



[Benzoic acid] [Glycocin] [Hippuric acid] [Water]

He investigated arsenic acid, a colorless crystalline com-

pound used in calico-printing. This led to his discovery of arseniureted hydrogen.

By adding a solution of copper sulphate to sodium arsenite he obtained the grass-green salt of cupric arsenite. This powder is well-known as Scheele's green. It is exceedingly poisonous, is used as a pigment, and in the treatment of anæmia, diarrhea, enterocolitis, and cholera morbus.

He made researches into the constitution of clay, quartz, and alum. Needless to say, his work on the alums was not nearly so important as Bergmann's.

He experimented with calculus, an animal concretion formed in various parts of the body, from which he was the first to secure uric acid. Human urine contains only a fraction of one per cent. of uric acid, but it is the principal nitrogenous constituent of the urine of birds and reptiles. Out of the three pints of urine daily excreted by the average healthy man, from .4 to .8 grams is uric acid.

In 1777 he published his book, *A Chemical Treatise on Air and Fire*, which can no more be compressed into the space of an article than the Baltic Sea can be put in a tub.

By heating sulphur with hydrogen he obtained hydrogen sulphide, and was the first to investigate this ill-smelling compound which gives the odor to the rotten egg. It is extensively employed in laboratories as a group precipitant and reducing agent. It was formerly used as an intestinal disinfectant, but fortunately 'the H_2S wash-out' now belongs to the past.

Scheele's name is intimately connected with the origin of photography, for it was he who scientifically investigated the darkening action of sunlight on silver chloride. Further, by means of a prism he threw the colored band of light upon a surface sensitized with silver chloride and noticed that the violet rays blackened it more readily than the other colors of the spectrum. By utilizing Scheele's experiments Thomas Wedgwood, of England, produced a photograph.

Of course, there is rarely an absolutely new discovery in

science, and if we wish to go a little further back we can see Johann Schulze working by a window — when the weather was warm and the sun was shining. He wishes to treat some calcium carbonate with nitric acid, and it so chanced that the acid he uses has some silver dissolved in it. He pours it on the chalk, the rays from the sun fall on the mixture and turn it black, while Johann is highly amazed to find that the effect of light is darkness!

If we travel back still more we learn that some sort of a beginning of photographic chemistry originated with the alchemists, and if no one has yet demonstrated that Aristotle was the original camera fiend, some one will come to the rescue in the near future.

Gladly giving due credit to all concerned, the fact remains that Scheele was the first who applied chemical and spectrum analysis to photography, which in the hands of the skillful has become a noble science and a fine art.

In 1778 he described a new method of producing calomel, the most valuable of the mercurial preparations.

He proposed a new way of making the powder of Algaroth, the purgative and emetic named after the physician Algarotus of Verona.

He examined molybdenite, which was thought to contain lead. He proved the contrary, and secured from the mineral molybdic acid.

In 1779 Scheele showed that plumbago consists almost wholly of carbon. During this year he published records of his former experiments.

In 1780 he discovered lactic acid and showed it to be the cause of sour milk, as the sugar of milk is transmuted to acid.

A quarter of a century later, Lagrange and Fourcroy and Vauquelin claimed that Scheele's new acid was merely impure acetic, and tho Berzelius — discoverer of sarcolactic acid in the juices of the flesh — combated this opinion, it was only in 1832, when Liebig and Mitscherlich analyzed the lactates, that the matter was definitely settled.

Just at present the distinguished Metchnikoff has brought lactic acid into extraordinary prominence. Everyone anxious to prolong his visit to Mother Earth is making and drinking 'buttermilk.' Numerous manufacturers are offering the lactic acid bacillus in all forms from loose powders to compressed tablets. Suspensions of the living lactic acid bacillus are now used in diseases of the nose and throat, and in genito-urinary work.

By boiling milk sugar with nitric acid, he obtained mucic acid. It is a white crystalline powder, practically insoluble in water, and on further oxidation yields racemic acid, an isomeric modification of tartaric acid, first obtained artificially in 1863 by Pasteur.

In 1781 he discovered the composition of the vitreous mineral tungsten. It has since been called Scheelite. He obtained from it, tungstic acid, which by means of nitric acid is precipitated as yellow crystals from solutions of tungstates.

In 1782 he experimented with that highly volatile and inflammable liquid, ether.

In 1783 Scheele boiled olive oil, litharge and water to get lead plaster. He obtained the plaster, but noticed also a liquid which was strange to him. He tasted it; it was sweet; it was Glycerin! So another important reaction was written down on Scheele's scroll.

This thick, oily, mawkishly sweet substance is now one of the indispensable necessities of the drug-store. 'Glycerin,' says Remington, 'is one of the most valuable liquids known to pharmacy.' If all the girls who rub Glycerin on their hands at night to keep them nice and soft, were to lay a sweet-smelling flower on Scheele's grave, the hanging gardens of Babylon would be outdone.

The remaining years of Scheele's life were devoted to the products from the acid saccharine fruits. He thus completed a cycle, for his first and last discoveries were made in the wide domain of the vegetable acids.

He extracted citric acid from lemons by a process still used.

The boiling juice is first completely saturated with finely powdered calcium carbonate, and the resulting precipitate of calcium citrate allowed to subside. When it is repeatedly washed with water and decomposed by dilute sulphuric acid, an insoluble calcium sulphate separates out, and the coveted citric acid remains in solution. This is then carefully concentrated in leaden boilers until a pellicle begins to form, when it is transferred to other vessels to cool and crystallize. Twenty gallons of lemon-juice should yield about ten pounds of the crystallized citric acid.

The citric acid is usually obtained from lemons or limes, it exists also in the juice of the gooseberry, strawberry, raspberry, cranberry, currant, cherry, orange, and many other fruits. Citric acid has been prepared artificially by Grimaux and Adam, who started with glycerin, produced chloro and cyano derivatives, and finally got citric acid itself. Recently Carl Wehmer has discovered that sugar solutions, if exposed to the action of certain mold fungi, become transformed into citric acid, and it is thought that this method of manufacture may replace the extraction from lemon juice.

In several of the world's pharmacopoeias citric acid has for its immediate neighbor another of Scheele's discoveries — gallic acid. Gallic acid exists free in nutgalls, in the leaves of the bearberry, in the root-bark of the pomegranate, and other vegetable substances. It is often found combined as a glucoside. It is prepared from the tannin of nutgalls, either by the action of dilute acids or by the change due to mold growths.

Malic acid is likewise in Scheele's Document of Discoveries. It is a deliquescent crystalline compound, with a pleasant acid taste, and occurs in the juice of most sour fruits. The most interesting characteristic of malic acid is the fact that it furnishes us with a remarkable example of physical isomerism, for when naturally obtained it rotates the plane of polarization, but when artificially prepared is optically inactive.

On oxidizing sugar with nitric acid, Scheele obtained an

organic acid which he named saccharic acid, now called oxalic acid. Oxalic acid is almost universally distributed thruout the vegetable kingdom. From water and carbon dioxide, by means of sunlight and chlorophyll grains, plants build up this compound.

The acid then combines with calcium carbonate and forms the crystalline calcium oxalate so valuable to the pharmacognosist as a means of recognition of powdered drugs.

Because of the certainty and celerity of its action, oxalic may supplant carbolic acid as the favorite of suicides when the dreaded phenol — on account of its ceaseless havoc among the laity — is altogether ousted from pharmacy. Oxalic acid can kill a human being in three minutes. Because of its resemblance to Epsom salts it has on several occasions been taken in mistake for that much-used saline purgative.

The only acid Scheele discovered which is called by his name is Scheele's dilute hydrocyanic acid (prussic acid), obtained by him from Prussian blue. It is four or five per cent., the official *acidum hydrocyanicum dilutum* of our pharmacopoeia being half that strength. In the concentrated form it is a rarity to be found only in the laboratories.

Prussic acid is found in the pits of apples, in the kernel of the peach and in the leaves of the laurel. If these are consumed in quantities, alarming — even if unexpected — illness may result. The acid occurs also in bitter almonds, and when their pulp is distilled we obtain the most poisonous of our official oils. Prussic acid is another standby of those intent on self-destruction, not only in real life, but in fiction. For instance, in Grant Allen's *The Woman Who Did*, the heroine Herminia — after being abused by her daughter — kills herself by drinking prussic acid. A remarkable feature of this deadly poison is the astonishing rapidity with which it causes death. A thief, who was pursued, swallowed a dose, staggered a few steps, fell to the ground and expired. A drop of the pure acid can kill a frisky dog in a second. Professor Doremus in an interesting letter to the *Standard Dictionary*,

says: 'I have held a drop of anhydrous hydrocyanic acid on a glass rod and brought it toward a live rabbit. Before it reached the animal, he dropped dead from inhaling the vapor.'

It is said that Scheele himself was suddenly killed by inhaling the vapors of the terrible poison he discovered, but while we hardly think this is the fact in his case, it is true that it has ended the career of more than one subsequent chemist.

The series of experiments which Scheele conducted in connection with Prussian blue — laying the important foundation of our present knowledge of the cyanides — has excited the enthusiasm of modern chemists, and with a tribute on this topic from the learned pen of Professor John Ferguson of the University of Glasgow, we close our meagre account of Scheele's momentous work:

'In 1782-1783 appeared a research which — of all those Scheele conducted — exhibits his experimental genius at its very best. By a wonderful succession of experiments he showed that the coloring matter of Prussian blue could not be produced without the presence of a substance of the nature of an acid, to which was ultimately given the name of prussic acid. He showed how this body was composed, described its properties and compounds, and mentioned its smell and taste, utterly unaware of its deadly character. Nothing but a study of Scheele's own memoir can give an adequate notion of the manner in which he attacked and solved a problem so difficult and complicated as this was at the period in the history of chemistry when Scheele lived. . . . His accuracy, qualitative and quantitative, considering his primitive apparatus, his want of assistance, his place of residence, the undeveloped state of chemical and physical science — was unrivaled. He grudged no labor to make the truth indisputable; and he evidently never considered his work complete about any body unless he could both unmake and remake it. For him chemistry was both an analytic and a synthetic science, and he shows this prominently in his researches on Prussian blue.

. . . The one aim of Scheele's life — and he never swerved from it — was the experimental discovery of the truth in nature.'

This was Scheele's aim. Whose aim was higher? This is what Scheele did. Who has done better?

High are the pointed peaks of Sulitelma, O Sweden! where the cooling cataracts rush down the crags of the mountain. In the Baltic is the island of Oland, whose rocks of Silurian limestone have battled for centuries with the god of storms. Near the North Cape rises a mighty slab of granite, thousands of feet in height, with every niche containing the nest of an Arctic bird. Calm are the waters of Mælar, and the falls of Motala turn the wheels of many mills. The lake of Vener is large, and Tornea Elf flows down to the sea. Famed is the hill of Kinnekulle, and who knows not the forest of Kolmorden? Uto is rich in the ores of iron; copper is found in Falu, and silver at Sala. There are mines of magnetite and hyperite, of granulite and dolomite. Among the trees of fir and pine the elk and roe deer search for browse, and the fleet-footed hare leaps thru the brush. Drove of leaping salmon crowd the rivers, and the herrings swim from the sea to spawn in the shoals. Over the snowy fields the great-horned reindeer wander, the whooper swan sails in the lakes of Lapland, and high in the frosty air soars the gyrfalcon and the golden eagle. Great indeed is the spectacle of the Midnight Sun, and when the Aurora Borealis flashes its dancing columns across the startled skies, the beholder stands with reverent heart and uplifted hand.

Yet boast not of these things, Sweden. Huge kings have sat on thine ancient throne, and hurled stout armies at the frightened nations. But be not proud of them. Do not sing of the Olafs and Erics, and seek not to perpetuate the memories of the vikings of old. We are sick of the bloody sagas of the skalds, and the fierce berserkers who cried Was-hæl among the reddish fiords. We have heard quite enough of your battle-axes, and we close our ears at the sound of the

hammer of Thor. Forget that victory at Narva, and scratch out the name of Charles XII.

Sweden, thou hast a greater glory. Thy name is on the lips of thinkers, and when the spirit of Science calls the roll of nations who have served her, thou canst answer in a triumphant voice, for Scheele is thy son.



(1731-1810)

CAVENDISH, THE CHEMIST



CAVENDISH, THE CHEMIST

Cavendish gave me once some bits of platinum for my experiments, and came to see my results on the decomposition of the alkalis, and seemed to take an interest in them; but he encouraged no intimacy with any one, and received nobody at his own house. . . . He was acute, sagacious, and profound, and, I think, the most accomplished British philosopher of his time.

—SIR HUMPHRY DAVY.

I DEFY any biographer to write an interesting sketch of Henry Cavendish. Some careers lack picturesque irregularities, but his was destitute of a single episode. He never sowed wild oats in the fields of life—only tame sweet-peas in the retired gardens of science. There was no dash of recklessness in his make-up. He passed his youth without committing an indiscretion. The wings of enthusiasm did not grow on his shoulders.

Even in the trivial affairs of daily existence, Cavendish had a mania for method. At the Royal Society he always hung his hat on the same peg; he would never ride in his carriage without measuring the miles; every morning not only were his boots found in a special position, but the point of his walking-stick was always standing in a particular way and in the same boot; at his mansion in Dean Street he fitted up a valuable scientific library which was at the disposal of all research-workers, and Cavendish himself would never take a book from it without signing a formal receipt; for dinner he had invariably a leg of mutton: on an unparalleled occasion, when some scientists were to dine with him, his housekeeper asked what was to be had for dinner. 'A leg of mutton,' said Cavendish. 'Sir, that will not be enough for five.' 'Then get two legs,' responded the charming host.

Cavendish could have given Amos Bronson Alcott lessons in the simple life; he was as frugal as a pastoral bard, and

no sodium urate enlarged his hallux; in truth, he had not those disorders that require the services of a medicus, nor was his existence ever enlivened by a law-suit, but his pathologic fear of the primate mammal was so pronounced, that anthropophobia should be popularly known as Cavendish's Disease.

To meet a young lady one night, and to have his arm around her waist the next night,—this was a pleasing miracle which he never accomplished. Cavendish did not even desire the sex. He was the model misogynist. It is admitted he was born of a woman, but she died when he was two years of age, and he never had a sister or a female acquaintance.

Cavendish, like Erasmus, was raised by his father, and like that wise monk who poked fun at monasteries and praised only Folly, he might have written: 'Two parents are the rule; no parents the exception; a mother but no father is not uncommon; but I had a father and never had a mother. I was nursed by a man, and educated by monks, all of which shows that women are more or less of a superfluity in creation. God himself is man. He had one son, but no daughters. The cherubim are boys. All of the angels are masculine, and so far as Holy Writ informs, there are no women in heaven.'

But Erasmus wrote the above letter to a lady, a dissipation in which Cavendish did not indulge. Moreover, Erasmus had a sense of humor, which Cavendish was minus. Nature must have been confused when she molded a sixteenth century monk more sociable than a modern British chemist. The critical reader will here discern that it was not this Cavendish who won fame as an authority on whist.

Such was this man's aversion to women, that happening to meet one of his maid servants on the steps, with a broom and pail, he ordered a back staircase to be built. At a certain hour of the day he left a note on the hall-table for his housekeeper to take unobserved, for any female domestic whom he saw, he dismissed.

He did not feel a tide of passion surge within him in the spring-time. He never succumbed to calf-love or the maturer variety. He formed an exception to Alice Lloyd's declaration, 'We all want something to cuddle.' He does not remind us, unless by the law of antithesis, of the young French author who confessed to Marie Bashkirtseff, 'Women are my passion.'

In short, we recall no other son of Adam who lived so sexless a life as Cavendish. It does no good to name professed celibates, for secret meetings between monks and nuns are not always fairy-tales, and Popes had the habit of being fathers not only in a spiritual sense. August Strindberg — a more violent woman-hater than Schopenhauer himself — has been thrice married. Sir Isaac Newton, who was so engrossed in differential calculus that he had no carnal knowledge, might have become a husband if his mind hadn't wandered to the realm of theory at the moment he was expected to woo. Amiel, the sad eremite of modern philosophy, yearned for wedlock. Herbert Spencer probably would have proposed to George Eliot if she hadn't run off with the homeliest man in London. Even Carlyle and Ruskin, impotent tho they were, took wives unto themselves, but if Cavendish had been shown a bodice, he might have analyzed its constituents, but would not have understood its functions.

Cavendish's relation to males was scarcely more intimate. It is fortunate circumstances never compelled him to perform that little conventionality called 'making a living.' There is nothing like travel to make a man reminiscent, and during 1785 and three other years, Cavendish journeyed thru the greater part of the island for geological and meteorological purposes. In his written record, not a single personal incident is related: only the heights that the barometer determined, and the strata that the hammer explored. Of the people he met by the way, of the wild scenery of Wales, there is no account. At Birmingham, Watt himself explained to Cavendish his improvements of the steam-engine. In his MS

Journal, Cavendish wrote, 'Mr Watt thinks to have ascertained by experiment, that the less heat water is converted into steam with, the more latent heat it requires, to assume the elastic form,' but how the great engineer looked, or how he spoke, Cavendish does not say.

Nor was Cavendish concerned with political affairs. He lived in the days of 1776, when John Hancock wrote his signature large enough for England's king to read without his spectacles, but Cavendish did not bother a rush whether the thirteen colonies along the Atlantic coast were ruled by George III or by George Washington.

The Ancient Mariner was alone on a wide sea; but Cavendish was alone in London. He had no friends, and rarely met a relative: his chief heir came to him but once a year and seldom stayed half an hour. No voice called him Harry. There are few lips which at some time or other have not spoken the familiar phrase, 'I love you,' but it is doubtful if Cavendish ever said as much to anyone as, 'I'm glad to see you.'

Had Cavendish not dined at the Royal Society, or attended the conversaciones of Sir Joseph Banks, he would have been a myth. Saint Catherine vowed not to open her mouth for nine years, but Cavendish uttered fewer words in the course of his life than any human being on record, except those who are born dumb. In truth, the tongue to him was an unnecessary organ, even as to the Trappist whose vow includes perpetual silence.

Because a man is shy and solitary does not imply he is a misanthrope. A certain type of recluse is often intensely eager for sympathy and companionship. But they are sensitive souls, afraid of being misunderstood by grosser grain. Their reserve is a mask which they wear, and put on like furs in December — for protection against the cold. These hermits come out of their retirement when the right person appears, and they then exhibit a depth of feeling of which others deemed them incapable. The bashful Hawthorne, for ex-

ample, found such a person in Sophia Peabody, for woman by virtue of her intuitive instinct is especially fitted to penetrate the barrier of reticence, and view what lies beneath the surface of apparent indifference. Yet it is extremely improbable that anything of the sort could ever have occurred to the bizarre chemist under consideration. Cavendish really seems to have been an iceberg in breeches which no warmth could melt. If man is a social animal, then Cavendish did not belong to the *genus homo*.

Amid the acclamation of the Romans, Terence exclaimed, 'Nothing that is human is alien to me,' but Cavendish reversed this maxim. He would not have been a member of Walt Whitman's Institution of the Dear Love of Comrades. He could not have appreciated Richard Burton's sentiment:

High thoughts and noble in all lands
Help me. My soul is fed by such;
But ah, the touch of lips and hands,
The human touch!
Warm, vital, close, life's symbols dear,
These need I most, and now and here.

We who grieve at the parting friend, and await his coming with joy, we who are met at the threshold of home, when the work of the day is over, with words of welcome, may shudder at the loneliness of Cavendish's life, and wonder if sometimes in the long night, as he walked thru empty rooms, encountering nothing more cheerful than a graduated jar or a metallic eudiometer, there did not vaguely gnaw at his heart the desire to see outlined against the smoldering fireside, a human form. On second reflection the thought is a vain one, for if Cavendish wished such society he could have called up his female servants and treated them to wine, as Ibsen's Chamberlain Alving used to do, but there is more blasphemy in this conception than in Edward McGlynn's idea of the Pope walking down Broadway with a plug hat on his head and a good cigar in his mouth.

Infrequently as Cavendish showed himself to his fellow-men, he sometimes underwent terrifying experiences in their company which must have caused him to vow to eschew even the dinners of the Royal Society and the soirées of Sir Joseph.

One evening, while the Fellows of the Royal Society were at supper, a pretty face watched them from an upper window on the opposite side of the street. Suddenly a learned Fellow lost interest in Lavoisier's views on combustion, and approached nearer the peeping beauty. One by one the philosophers left the table and concentrated around the window, thus proving Edward Clodd's contention, 'Emotionally, we are hundreds of thousands of years old; rationally, we are embryos.' Cavendish naturally thought the F. R. S.'s were studying the moon, but he mistook the planet. When he himself came to the spot and saw what his colleagues were observing, he turned away in the deepest disgust, audibly grunting his disapproval, for he was not a poet and did not believe that astronomy could be studied in a lady's starry eyes.

On the occasion of a gathering at Sir Joseph Banks', Dr Ingenhousz formally introduced a foreign friend to Cavendish, explaining how anxious he was to meet such a profound and celebrated thinker. Dr Ingenhousz's friend then assured Cavendish that he had come all the way from Austria principally to see and speak with one of the greatest ornaments of the age. As far as conversing with Cavendish went, the countryman of Marcus Plenciz might have remained in the Tyrol, for Cavendish answered never a word. The unhappy object of admiration had seen what was to him the horror of horrors — a strange face. Stricken with anthropophobia he stood there, with eyes cast down, in an agony of embarrassment, till he saw an opening in the crowd and darted away in a manner that recalled Newton's first law of motion: 'A body in motion moves uniformly in a straight line unless acted upon by some outside force.'

A Fellow of the Royal Society informed Charles Tomlinson, who was collecting material for Dr George Wilson's *Life*

of Cavendish, 'I have myself seen Cavendish stand a long time on the landing, evidently wanting courage to open the door and face the people assembled, nor would he open the door until he heard some one coming up the stairs, and then he was forced to enter.'

Then he came slouching along, uncanny in his awkwardness, with one hand behind his back, looking neither to right nor left, shuffling quickly and yet with hesitation, uttering a shrill cry if watched; the oddest figure of them all, dressing in old-fashioned gear: cocked hat, high coat collar, frilled shirtwaist, faded violet clothes, knocker-tailed periwig.

When some unusual occasion caused him to make use of his vocal chords, his voice was found to be squeaky, like a pulley that has not been recently used. The new Fellows found it expedient to follow Dr Wollaston's advice, 'The best way to talk to Cavendish is never to look at him, but to talk as if it were into vacancy, and then it is not unlikely but you may set him going.'

Kerseboom painted Boyle, Fuseli painted Priestley, Faulkner painted Dalton, Sandberg painted Berzelius, Lawrence painted Davy, but no brother of the tribe of Joshua Reynolds could induce Cavendish to enter his studio.

Cavendish never imagined that his lineaments would descend to posterity, but an adventurous artist named Alexander, managed at a scientific meeting to sketch him surreptitiously, and the drawing is now preserved in the print room of the British Museum, for all the world to gaze upon.

But not even his suburban villa at Clapham Common,—where grew a large tree which he ascended for his electrical and astronomical studies—was always safe from the intrusion of outsiders. Indeed, one day Cavendish was frightened to hear the voice of his servant, 'Sir, there is a person below who wants to speak to you.'

'Who is he? Who is he? What does he want with me?'

'He says he is your banker and must speak to you.'

‘Send him up. Send him up. . . . What you come here for? What do you want with me?’

‘Sir,’ replied the borrower and lender of currency, ‘I thought it proper to wait upon you, as we have a very large balance in hand of yours, and wish for your orders respecting it.’

‘If it is any trouble to you, I will take it out of your hands. Do not come here to plague me.’

‘Not in the least trouble to us, Sir, not in the least; but we thought you might like some of it invested.’

‘Well! Well! What do you want to do?’

‘Perhaps you would like half of it, say, forty thousand pounds, invested.’

‘Do so! Do so! and don’t come here to trouble me, or I will remove it.’

This ungracious man, who never had more than one suit of clothes at a time, was not a country bumpkin raised in a village. He was a lord and a millionaire, the most high-born chemist that Britain has produced. Heredity forgot, however, that one of his forefathers was Thomas Cavendish, the daring freebooter who circumnavigated the globe, burning and robbing Spanish ships on the watery way, and came sailing home with a crew clothed in silk, sails of damask, and a topmast covered with a cloth of gold. The house of Cavendish had long been illustrious: when a Cavendish died his corpse was met at the entrance of the town by the mayor and thirty burgesses in mourning. Henry Cavendish was the grandson of a duke by both parents, and the nephew and the cousin of one. He traced his descent back to a Norman family famous in the days of William the Conqueror, and his ancestors were connected by intermarriage not only with high aristocracy, but with the royal families of England and Scotland. But certainly our Cavendish had no interest in his Norman pedigree; it is bad enough that Lord Byron did. Cavendish kept no coat-of-arms, but he adopted this motto: ‘Let me alone.’

We frequently observe that a human being who separates

himself, or is cut off from his fellow-creatures, seeks solace in the healing powers of nature.

There is a pleasure in the pathless woods,
There is a rapture on the lonely shore,
There is society where none intrudes,
By the deep Sea, and music in its roar.

The most ungregarious of American authors, who said he would rather sit on a pumpkin and have it all to himself than be crowded on a velvet cushion, lived alone in the woods, for he was in love with a beautiful pond. When the brilliant and broken outcast of British literature languished in cell 3.3, he did not think on his release to find a home among the haunts of men, but wrote from the depths, 'Society will have no place for me, has none to offer, but Nature, whose sweet rains fall on unjust and just alike, will have clefts in the rocks where I may hide, and secret valleys in whose silence I may weep undisturbed. She will hang the night with stars so that I may walk abroad in the darkness without stumbling, and send the wind over my footprints so that none may track me to my hurt: she will cleanse me in great waters, and with bitter herbs make me whole.'

But Cavendish was as indifferent to nature as to man. He could not declaim with Manfred:

I linger yet with Nature, for the night
Hath been to me a more familiar face
Than that of man; and in her starry shade
Of dim and solitary loveliness,
I learn'd the language of another world.

Cavendish never slept under the stars, or swore that only the clouds are real. The monarch of mountains, crowned with a diadem of snow, furnished him no inspiration. He never saw tears in the drooping eyes of the modest violet. The cowslip's chalice held no gold for this chemist. He did not muse on the circumstance that each blade of grass, tho

useless in its isolation, helps to form the green mantle that covers the bare shoulders of Mother Earth. The tints of morning, when the young sun rises in splendor to illumine a universe, never stirred his primitive instincts. The murmuring waters and the distant hills, that make orators eloquent and young girls sentimental, were only bosh to him. The wan and melancholy moon that causes youths and maidens gay to exchange tender vows, never affected the systole and diastole of his cardiac region. He walked out in the dusk after the twilight, not to hear the notes of philomel, but to escape the gaze of man. Blind to beauty and deaf to melody was this individual. No wonder his biographers Cuvier, Thomson, Kopp, forgot he was born in Italy — where his mother had gone for the benefit of the waters. The words sublime and beautiful were not in his vocabulary — so he could not have written Burke's essay. His lack of the esthetic sense could be observed in his laboratory, for he never cared how ugly his apparatus looked, so long as it was as accurate as possible. In his dry soul, there was not an atom of the artist. He did not even see the poetry of physics.

And to think that only a stroll from his Clapham villa lived Blake the esthete, going mad with dreams of color, piping himself into paradise with gorgeous phrase.

Voltaire said, 'When a woman is no longer acceptable to man, she turns to God,' but this cutting sarcasm, like most androcentric epigrams, equally fits the sterner sex. Half the decadent poets, rejected of men, died in the numbing arms of the Catholic Church. Did Cavendish turn to Jesus Christ for comfort? He did not; he never attended a place of worship, and had no religion. It is thought he left Cambridge without a diploma, because he did not care to submit to the theologic red-tape required of all candidates for degrees. Evidently, he was unwilling to argue about Eve's serpent, Elijah's sparrows, Jonah's whale, or Balaam's ass. During his geological trips he used his chisel every day in the week, and some of his most important discoveries in chemistry were



H. Cavendish

made on Sunday. Shall we therefore say he violated the commandment, 'Remember the Sabbath day to keep it holy?' Shall we not rather demand wherein is it unholy to add to the treasure-house of Science?

Theologically speaking, Cavendish lived in a backward age — the age in which the fanatical Autocrat of English Literature cast a slur on every liberal thinker in Europe, while the priggish Boswell stood by, clapping his little hands in glee. Johnson would remain on his knees in prayer for hours at a time — except when he had previously taken a dose of squill.

Cavendish's unbelief was both remarkable and refreshing, for of all people in the world the Anglo-Saxons are the most offensively pious. For example, when Captain Cook was about to make his second voyage around the world, the discoverer of nitrous oxide was invited to accompany the expedition in the capacity of naturalist. Priestley agreed to the proposition, and already had visions of strange stars and savages, but he was rejected by the clerical members of the Board of Longitude, not because he was deemed ignorant of science, but because he was unable to feel himself entangled in Adam's guilt.

The same generation that saw an infuriated mob break into Priestley's home at Birmingham, tear his manuscripts into shreds, destroy his electrical apparatus, and smash the earthenware that Josiah Wedgwood sent him, witnessed all Paris entertaining David Hume — the skeptic whose pen scratched the word 'miracle' from the domain of truth.

So Cavendish existed: without affection for Man, without interest in God, without belief in Satan; and when he passed out of the world, almost in his eightieth year, no one was at his bedside: no heir, servant or scientific acquaintance; neither doctor, lawyer nor priest,— not even a faithful heart-broken dog. Buddha would have hailed Henry Cavendish the greatest of Occidentals — he had no desires.

Thus far, this has been a narrative in the negative. We

have overused 'not' and 'never'; Cavendish was not this, and Cavendish never did that. But Cavendish must have been something, for altho he dreaded the loud hand of applause and quivered at the glaring eye of notoriety, his memory has survived the vicissitudes of a century, while millions of men who fought for fame have dropped into forgotten graves.

Eminent as Cavendish was in his day, he would have been more celebrated had he possessed any desire for distinction. But his place in chemistry is analogous to that of Edward Fitzgerald in poetry, who made 'efforts to remain within the shadow of anonymity.' A number of Cavendish's papers were published in the *Philosophical Transactions*, but often he would perform a series of experiments, write out the results, and then put the MS away; twenty years later he might publish it, as he did his *Experiments on Heat*, or he might leave it unpublished as he left his *Density of the Atmosphere of the Earth and of Jupiter*. The unfortunate result of this habit was that scientific men would have to spend considerable time making obtruse researches with which Cavendish was already familiar.

For instance, Michael Faraday had to discover for himself the difference of the capacities of various substances for taking part in electric induction, but had he been permitted to peer into Cavendish's drawer, he would have learnt that that owlsh individual had not only discovered that rosin, shellac, wax and glass have higher specific inductive properties than air, but had even determined the numerical ratios of each. Biot also added a new wrinkle to his forehead pondering over problems which Cavendish had previously solved. Even Volta, after whom we have named an entire department of electricity, was forced to make experiments to which Cavendish already knew the answer.

The mind balks at Cavendish's unconcern for laurels: researches which would have established a deathless reputation, electrical memoirs which Clerk Maxwell has been glad to

edit, were never sent by their author to a printer. How opposite from the lively Priestley, whose manuscripts would be put into pica before the concluding paragraph was blotted and dried. But Cavendish could not escape immortality: he who does superb work is in danger of being remembered.

Cavendish was a natural philosopher: master of several branches of science. We write of him chiefly as Cavendish the Chemist, but another could call his essay Cavendish the Electrician; a third could tell of Cavendish the Mathematician; a fourth could speak of him as Cavendish the Meteorologist; a fifth could describe Cavendish the Geologist; and a sixth could fill a paper on Cavendish the Astronomer.

We have few such men nowadays, because each separate part of each different branch of science has developed so enormously, that Specialization is necessarily the cry of our age. The German professor who spends twelve years tickling the roots of plants, and writes three weighty tomes on the theme, is undoubtedly an expert on certain botanical problems, but he can know only enough zoology to distinguish a zebra from a kangaroo.

We gladly turn from the pitiful picture of Cavendish in society, to the nobler one of Cavendish in his laboratory. Undisturbed by others, he performed his experiments with a patience that never tired, and an accuracy that has been the marvel of succeeding ages. His great merit lies in the fact that so much of his work was quantitative as well as qualitative. The name of Cavendish is a synonym for exactitude.

This does not mean that he made no mistakes, for the sponge of science has erased more than one of his conclusions. Most of his blunders were due to his adherence to the phlogistic doctrine. This theory of Becher and Stahl's, that every combustible substance contains a constituent given up in burning, called phlogiston,—from the Greek word *phlogistos*, meaning inflammable—has now vanished as completely as Kunckel's notion that every metal contains quicksilver, but in its day it worked much havoc.

Phlogiston was indeed the will-of-the-wisp of chemistry which confused Priestley, puzzled Watt, upset Boerhaave, deceived the wise Scheele, lured Kirwan on to error, and often led Cavendish astray.

Chemistry can never be too grateful to Lavoisier — plagiarist tho he was on at least two occasions, trying to steal the discovery of oxygen from Priestley, and the discovery of the composition of water from Cavendish,—chemistry, we say, can never be thankful enough to the illustrious French savant for exposing the fallacy of phlogiston. Out of the whole phlogistic jargon, only a single word survives in modern chemical nomenclature: eudiometer.

Among Cavendish's early experiments was an investigation of the properties of arsenic, by which he learnt that arsenical acid contains more oxygen than does arsenious, and the latter more than the metal.

He introduced the word 'equivalent' into chemistry, and proved that the combining proportion between base and acid follows a distinct law.

He analyzed the Rathbone Place water, thus making one of the earliest satisfactory analyses of a mineral water; he was the first to explain what is known as the hardness of water; he showed the solubility of bicarbonates of lime and magnesia in water.

He was selected by the Royal Society to describe their meteorological instruments, and Cavendish did not disappoint the Fellows by his account of the rain-gauge, hygrometer, variation-compass and dipping-needle. It should be remarked that his father, Lord Charles Cavendish, was a meteorologist of distinction.

No one could graduate thermometers with such skill as Cavendish; he was always fortunate where mercury was concerned; he and Priestley initiated the method of using quick-silver to collect and preserve certain gases which are absorbed by water.

Rutherford is usually regarded as the discoverer of nitro-

gen, but Cavendish, like Scheele of Sweden, was an independent finder of the inert element, and wrote the first clear description of it as a distinct gas.

He gave the best account of carbonic acid and the carbonates; he knew that cold water dissolves more carbon dioxide than hot. It is safe to say, however, that he never guessed how important a part carbonic acid gas would play in the great American beverage, nor how often the enamored swain would inquire of his perspiring affinity, 'Will you have a glass of soda-water?'

Cavendish found that a solution of one part of salt in one part of water conducts a current 100 times better than fresh water, and that a saturated solution of sea-salt is 720 times as efficient. 'Among the cultivators of electricity,' says Professor Chrystal, 'Henry Cavendish is entitled to a distinguished place.'

The value of his researches on the nature of heat was second only to those of Dr Black. He was probably the first who collected tables of specific heats of various bodies, for Cavendish revelled in figures like a poet wallows in adjectives.

For an example of his circumspection, we may quote a passage from Dr Wilson: 'We find Cavendish collecting the elastic fluids on which he experimented, with various precautions to secure their purity, observing carefully from how many different sources they could be procured with identical properties, and determining with numerical precision the relative volumes yielded by different processes. The questions of their permanent elasticity, their solubility in different liquids, their combustibility or power to support combustion, their specific gravity, and likewise their combining equivalent, were all carefully inquired into.'

During the winter of 1759, Professor Braun was at St Petersburg, and when the Russian chill sent the quicksilver 34° below Fahrenheit's zero, the Professor stuck his thermometer into a freezing mixture of snow and nitric acid. Immediately the hydrargyrum descended with great rapidity, and

after adding fresh supplies of the freezing mixture, Braun watched the mercury fall as low as -352° . He then removed the thermometer, breaking the bulb, and his astonished eyes saw what had never been seen before: solid mercury. Instead of an eternal fluid, he had before him a metallic mass which could be hammered like lead.

'So mercury can solidify,' correctly quoted the surprised Professor as he blew on his frost-nipped fingers, but he forgot to take into account the phenomenon that mercury contracts, becomes denser and therefore sinks when congealed, and he accordingly promulgated a grave error: that the freezing point of mercury is about four hundred degrees below Fahrenheit's zero.

Some years later, at the request of the Royal Society, Governor Hutchins at Fort Albany, Hudson's Bay, repeated this experiment, and confirmed the result. But Hutchins could not determine, even approximately, the point at which mercury passes from the liquid to the solid state, for when the mercury is enclosed in the thermometer it is impossible to see how much of the contraction is due to cooling and how much to congelation.

Cavendish, however, understood the true nature of congelation, and — like Black — knew from experiment that when a liquid is undergoing solidification, its temperature, after it first begins to freeze, remains stationary until it is entirely frozen. With this principle in mind he constructed an apparatus which was sent to Hudson's Bay. By employing it, the Governor learnt that the congelation point of quicksilver is only -39° , and that its rapid descent thru several hundred degrees, which Braun and he himself had observed, proceeded merely from the contraction which the mercury underwent in the act of freezing, and not from the degree of cold produced.

Cavendish deserves much credit for saving scientific men from the absurdity of accepting fantastic notions of temperature.

His naval ancestor, whom we have previously mentioned, was the third man who sailed around the world; he himself was the first who weighed our terrestrial home. He performed the experiment by means of the torsion balance which had been invented by John Mitchell, a gentleman who would have been his friend, had Cavendish been able to respond. Out of the endless number of experiments that have been performed in science, only a few have become phrases and passed into technical literature with their author's name prefixed; for instance, Torricelli's Experiment, Oersted's Experiment, Scheiner's Experiment, and Cavendish's Experiment. Just as the first is invariably known to refer to the discovery of the principle of the mercurial barometer, the second to signify a phase of electromagnetism, a third to mean a phenomenon in vision, so the fourth alludes to the density of the earth. Cavendish's Experiment is outlined in the majority of elementary text-books on the science of energy, but I will not use Macaulay's favorite expression, 'every schoolboy knows,' because I have gone to school, and I know that every schoolboy forgets.

Yet the most retentive of us may have a dim recollection that in Daniell's *Principles of Physics*, we had to study an account of Cavendish's Experiment which read somewhat as follows: 'This was a direct measurement of the attraction of masses for one another. Light balls were poised on a rod and their position carefully noted; large balls of lead were carefully brought near them; the light balls were attracted by the heavy masses, and their displacement measured. Great experimental precautions were necessary, such as the observation of the position of the balls with a telescope placed at a distance, the avoidance of draughts of air and of vibrations; the result showed that if lead balls had been employed as large as the earth, the attraction of such balls would have been greater than the actual attraction of the earth in the ratio of 11.35 to 5.67; but lead is 11.35 times as heavy as water, hence the earth as a whole is 5.67 times as heavy as

an equal bulk of water; or the density of the earth is 5.67.'

He analyzed the atmosphere, his estimation of the mean composition of air in 100 parts by measure, being oxygen 20.8 and nitrogen 79.2. According to the modern computation the ratios are oxygen 20.9 and nitrogen 79.1.

Cavendish guessed the existence of another gas in the atmosphere, and even surmised its amount. One hundred and ten years later, two skillful English scientists — by an interesting coincidence working near the house where Cavendish had lived — repeated Cavendish's experiments, and learnt that the nitrogen obtained from the air was a half per cent. heavier than the nitrogen procured from chemical compounds, such as nitrous oxide, nitric oxide, ammonium nitrate. A closer investigation of this phenomenon led to the discovery of argon in the air. So we see that Lord Rayleigh and Sir William Ramsay found and proved what Cavendish had only prophesied, but they had at their service means of absorbing nitrogen, methods for liquefying air, and above all, spectrum analysis. That is why a couple of bubbles in a capillary tube opened a new era in theoretical chemistry.

Cavendish was not exactly the first who investigated the specific gravity of gases, but he was the first who ascertained that they have different densities. His specific gravity for carbon dioxide was 1.57; ours is 1.524: admirable precision for a chemist whose apparatus we would relegate to a museum of antiquities.

Hydrogen had been casually noticed by Paracelsus, Boyle, Mayow; and indeed, many experimentalists who had thrown acids on metals had seen a gas rise, but Cavendish is considered the discoverer of the lightest substance known, because he made the first investigation and wrote the first distinct account of its properties. It is fitting that Cavendish should have described hydrogen, for the gas is symbolical of its discoverer — having little desire to unite with anything else, being invisible, and trying to escape when confined.

He found hydrogen 11 times lighter than common air;

we now know that hydrogen is 14.4 lighter, but as his predecessors could not distinguish any difference between the gravity of hydrogen and the atmosphere, and believed all gases to be of equal weight, his approximate calculation is astonishing. But of course this was Cavendish's only function in life — to weigh things and measure them and analyze them.

Cavendish's discovery of the lightness of hydrogen was the nucleus around which developed a daring and noble art:

Among the picturesque hills of Annonay, dwelt old Peter Montgolfier, manufacturing paper-bags that brought him comfortable money. He had two sons, Stephen and Joseph, who helped him in the business, but also spent considerable time reading Priestley's and Cavendish's essays on different kinds of air,—and watching the clouds on high. They wondered what would happen if they could imprison a bag in a cloud: would it rise and float above their heads, sailing beyond the church-steeple and over the tree-tops.

It was not so easy to catch a cloud, but since hydrogen was so very light, why not try that? They did make the attempt, tho an unsuccessful one, for the paper proved permeable to the gas. But the sons of Peter Montgolfier were prejudiced in favor of pulp, and instead of abandoning the paper as an unsuitable envelope for the gas, they sought for another gas more suitable for the paper.

Smoke ascended: every naked savage knew that. If a bag should be filled with smoke, would it not also ascend? How strange that some restless intellect, an Aristotle or a Paracelsus or a Newton, had never thought of it!

The Montgolfier brothers filled a bag with smoke, and the bag arose; they raised their hands, but the heated air carried the bag beyond their reach — higher than any house in the village. So the first balloon sailed in a little town that had nothing to make it famous except a Gothic church built in the fourteenth century.

The Montgolfiers came to Versailles to amuse the French court; and as Louis XVI and Marie Antoinette required all

they saw to be gorgeous, like their too-ornate palaces and over-gilt carriages, the balloon was showily painted with ornaments in oil. An osier cage was suspended at the bottom, and in it were placed a sheep, a cock, and a duck: the first aerial passengers — except of course the birds that travel on the wing. The balloon mounted to a height of 1500 feet and remained in space till the hot air acquired the temperature of the surrounding atmosphere — in eight minutes — and then descended in the wood of Vancresson, two miles distant. The sheep kicked the cock, hurting its right wing, but otherwise there were no accidents. Thus, amid the masque of powder and the scent of patchouli, was born the art of aëronautics.

Naturally these experiments excited every alert mind: Would man learn to aviate the atmosphere? Would the fabled wings of Dædulus become realities? Young Jenner made a balloon of his own, and old Euler was all agog. Leonard Euler was the greatest mathematician of the century. The hand of the potter did not shake when he was molded: he had a giant's strength and an intellect that matched. But Euler abused his privileges. In three days he solved a problem that took other experts months. He found the answer, but nature protested. Euler sank to his bed in a fever, and when he rose, there was no sight in his right eye. The mighty man laughed, and continued his work. A cataract formed in his left eye, making him practically blind. But Euler did not cease his investigations. Then Wenzell came to the mathematician, and couched his cataract, and Leonard Euler once more saw his wife and children. 'Take care,' said Wenzell, but Euler studied day and night, till sight left him again. But Leonard Euler worked on. He was throwing light on every phase of mathematics — how could he stop for his own physical darkness? Age advanced upon him, but he continued his researches, dictating memoirs on planetary perturbations, perfecting integral calculus, creating the subject of partition of numbers, inventing the calculation of sines, nearly squaring the circle, winning prizes from even the Ber-

nouillis. Scornful of infirmities, his magnificent activities would have exhausted a score of lesser men. He had long passed the allotted years of the psalmist when he heard of the ascensions at Annonay. The mathematical theory of the motion of a balloon engrossed a mind that knew so well the motions of planets. The skilled hand grasped the chalk, and when great Leonard Euler was dead,—having ceased to calculate and to breathe at the same moment—his blackboard was found covered with his last investigation: the rate of ascent of a balloon.

At this time a balloon was constructed in Paris by the brothers Robert, under the direction of Jacques Charles. The latter gentleman was a professor of natural philosophy, and desired that his balloon,—which was of silk, and varnished with a solution of elastic gum—be filled with hydrogen instead of hot air. For a few days the gas was prepared by throwing five hundred pounds of dilute sulphuric acid on a thousand pounds of iron filings, but one day the balloon disappeared from its accustomed spot, the Palace des Victoires. Too great a crowd had gathered there, and during the night, preceded by torches and guarded by soldiers, the precious object had been conveyed to the largest open space in Paris, the Champ de Mars. The next day a cannon-shot gave the signal for the ascent, and the balloon circled three thousand feet above the immense sea of faces that watched below. The rain descended, wetting the balloon and drenching fair ladies, but no one paid any attention to the shower. For three quarters of an hour the balloon sailed in the elastic fluid, finally falling in a field where some frightened peasants tore it to fragments.

But the superiority of inflammable air—as hydrogen was then called—over hot air was demonstrated, and the future of ballooning was assured. As far as science is concerned, this was important for at least two reasons. In the first place, some scientific experiments of value were performed by means of the balloon, as can be seen without leaving Cavendish's own work: Cavendish, as mentioned above, determined the

composition of the atmosphere, showing the exact relation between its two most important ingredients, nitrogen and oxygen. He made hundreds of experiments which proved that the composition of the atmosphere is constant, it being immaterial whether the air to be analyzed is collected on fair days or foggy, or from the pure country or the sooty city.

This led some chemists, such as Prout and Thomson, to maintain that the air must be a chemical compound. But John Dalton, discoverer of the Atomic Theory, correctly insisted that the air is merely a mechanical mixture of constant composition. He believed, however, that since nitrogen is lighter than oxygen, the relative amount of the two gases varies at different heights from the earth's surface, the nitrogen increasing and the oxygen diminishing as we ascend.

To see if this were true, Gay-Lussac collected the atmosphere in the streets of Paris, and also gathered air in a balloon at an elevation of seven thousand meters, for the chemist who climbed Vesuvius when the volcano was vomiting violently, was likewise the most enthusiastic aeronaut of the day. His analysis, which has since been placed beyond doubt, proved there was no change in the proportion of nitrogen and oxygen. In this work, Gay-Lussac was aided by Thenard, the discoverer of hydrogen peroxide. We do not believe with the alchemists that the baser metals can be transmuted into gold, but we know that the application of hydrogen peroxide turns a brunette into a blonde.

In the second place, ballooning accustomed men to navigate the atmosphere, and thus prepared the way for the introduction of the *aéroplane*,—and for Langley, Zeppelin, Bleriot, Farman, Santos-Dumont, Arch Hoxsey, Hugh Latham, Glen Curtiss, the Wright brothers, and all the glorious bird-men who yesterday conquered the empire of the air.

The laboratory method of Cavendish was not only orderly, but organized. He did not leap from subject to subject with the speed that Priestley forsook one road of research for a more novel path. Priestley performed his experiments with

enthusiasm and ease. He was a great man and a careless one. He would announce a new theory before breakfast, reject it at lunch, and formulate another at the supper-table. He made discoveries or mistakes with equal nonchalance.

Priestley was like a wonderful child amusing himself with apparatus. For the 'entertainment of a few philosophical friends' he performed what he called 'a random experiment,' which consisted in exploding hydrogen and oxygen in Volta's electric eudiometer. After the spark had passed, a dewy deposit was found on the sides of the glass, but Priestley paid no attention to the moisture. This was by no means the only occasion on which the versatile doctor had an important discovery nearly in his hands, and brushed it aside for a more cautious observer to pick up.

Among the philosophical friends who witnessed Priestley's experiment was John Warltire, who wanted to know whether heat is heavy, and with this object in view he burned the gases several times, and weighed the flask after the explosion and after it cooled, reaching however the incorrect conclusion that heat is a ponderable body.

At this time Cavendish was working with the air, and as soon as he heard of Priestley's and Warltire's experiments, he repeated them. He took greater precautions than Warltire, and finding no difference between the first and second weighing, satisfied himself that heat is not a material entity.

Nor did he disregard the deposit of dew which Priestley passed by so heedlessly. On the contrary, Cavendish considered it as 'likely to throw great light on the subject and well worth examining more closely.'

Various explosions were now heard in the Cavendish laboratory, till it was ascertained that when one volume of oxygen is detonated with two of hydrogen, the gases combine to form a liquid which proved to be water!

Since the dawn of inquiry, when man first speculated on the composition of substances, water was considered an element. Egyptian magician, Chaldean priest, Greek philosopher,

Arabian alchemist, German iatro-chemist, and all subsequent chemists looked upon water as a type of an indivisible substance, which could not be decomposed into anything simpler. Microscopic monocellular organisms of the plant and animal world, daily splitting up water into its component gases for their daily needs, knew better, but they could not write textbooks. The Honorable Henry Cavendish, who resided on the corner of Montague-place and Gower-street, near the British Museum, was the first human being to know that water is a compound, capable of being built up from its elements. It was a synthesis that advanced the science of chemistry. Did the eyes of this strange man glisten with a little joy?

Yet his views on the nature of water were not as certain as the modern conception. He was prevented from seeing too clearly by the bandage of phlogiston.

On certain occasions, while detonating common air with hydrogen, Cavendish obtained not only water, but traces of nitric acid. At that period there was not a chemist in Europe who could have explained the occurrence, but Cavendish with his intellectual bull-dog tenacity, attacked and stuck to the problem till he discovered that its production was due to the nitrogen of the atmosphere which had combined with the oxygen and hydrogen.

Joseph Black, founder of the chemistry of the gases, considered this discovery 'as one of the most important in the whole science of chemistry.' The veteran was so enthusiastic because of the light which it threw on the theory of his beloved science.

It explained, for instance, the production of nitrates in the soil. Long before a speck of protoplasm thought of becoming a man, the lightning flashed and converted a portion of the atmosphere into nitric acid, and the rains washed the aqua fortis to the earth, but it was reserved for Henry Cavendish to supply the key for this closed door.

Certainly, an imperfect life; a life that too forcibly recalls Browning's complaint:

Each life's unfulfilled you see,
It still hangs patchy and scrappy;
They have not sighed deep, laughed free,
Starved, feasted, despaired, been happy.

Hands that never helped a friend, and never fought for the world's prizes; lips that never trembled with rage, and never knew the kiss of love; a heart that never sank in sorrow, and never rose in ecstasy. Passions, none; emotions, absent; fellowship, blank; but he weighed the earth, he experimented with fire, he analyzed the air, he discovered the composition of water. Earth, Fire, Air and Water — the original elements of Empedocles: let us honor the brain that enlarged the boundaries of knowledge.



(1728-1793)

HUNTER, THE NATURAL PHILOSOPHER



HUNTER, THE NATURAL PHILOSOPHER

When we make a discovery in pathology, we only learn what we have overlooked in Hunter's writings or forgotten in his lectures.

—JOSEPH ADAMS.

Hunter's operation for aneurism introduced into surgery an improvement which has been more fruitful in important results than any since Paré's invention of the ligature for divided arteries.

—DREWRY OTTLEY.

THE old Laird of Long Calderwood must have felt that he had been a sire once too often: he was nearly seventy years when his tenth child was born, and the offspring of his age was a terror: red-headed, unruly, impudent and unwilling to learn.

Every Scotch parish has its grammar-school, but little Jack Hunter had an astonishing antipathy towards teachers. And as he was extraordinarily obstinate, while his mother was unusually indulgent, he grew up unmolded by education. He was a shameful contrast to his elder brothers who were studying law, theology and medicine. Yet folks could not consider Johnny a stupid bairn, for he was everlastingly plaguing them with questions which they could not answer. He wanted to know so many useless things — what the clouds are, and why the leaves change color in autumn, and how the tadpole becomes a frog.

It is easy enough to waste time, and at twenty John Hunter was still idle and ignorant, tho quick-witted and full of fun. But he began to feel that it was time even for him to begin to do something in the world, especially as his brother William, ten years his senior, was already famous in London as a medical man. He wrote to William, asking if he might work under him — otherwise he would enlist in the army. William answered him cordially, and John Hunter mounted horse for the metropolis.

The young adventurer was poor and was seeking his fortune, but he was not exactly an Horatio Alger hero. No Sunday-school superintendent could have proclaimed him a model for youth to follow. He associated with loafers, and gave himself up to the pleasures of the flesh. Forgetting the advice of his good mother, he did not pray to be delivered from the evil of the great city, but smilingly met temptation in a rollicking spirit — with a wine-bottle in his hand and a doxy on his knee.

No one who saw him in the shilling gallery bawling with his companions at a production of a dramatist that displeased these critics, would have taken him for the brother of the cultured William Hunter, a typical university product, a picture of fastidiousness and finesse, well-dressed and at ease in high society, a polished agate — but John was a diamond in the rough.

William Hunter, the first great teacher of anatomy in England, was not content to illustrate his lectures with the cadavers of dogs; he employed human specimens, and after his brother came to London he thought he might engage him in the capacity of demonstrator. So he told him to try to dissect the muscles of the arm. John took the scalpel, and like another Vesalius, prepared a flawless specimen. The elegant William looked with surprise at this untrained clout who dissected so skillfully. He then gave John another arm, but with the blood-vessels injected, and this time he was to expose not only the muscles but the arteries, yet when John laid down the knife, his admiring brother informed him that he would be a good anatomist.

He now began to study at Chelsea Hospital under Cheselden, who could perform a lithotomy in fifty-four seconds, and at St Bartholomew's Hunter became a pupil of Percival Pott — the gentleman who had such a sense of the fitness of things that he composed his *Treatise on Ruptures* when he lay in bed with a compound fracture of the leg.

In 1753, when John was twenty-five years of age, his

brother persuaded him to register as a Gentleman Commoner at St Mary's Hall, Oxford. In less than two months John left the classic institution, but he never forgot the experience. 'Why,' he used to say, 'they tried to make an old woman of me; they wanted to stuff me with Greek and Latin at the University, but,' and he pressed his thumb-nail on the table, 'these schemes I cracked like so many vermin as they came before me.'

John returned to his beloved dissecting-room, and here he learnt enough to be able to say of a rival surgeon, 'Jesse Foot accuses me of not understanding the dead languages; but I could teach him on the dead body what he never knew in any language living or dead.'

About this time the mode of the connection between the placenta and the uterus was discovered, but whether by William or John it is difficult to say, as both brothers claimed the honor. However, the unpleasant incident seemed to be forgotten, for in the same year, 1754, John commenced to deliver lectures in his brother's school — an occupation in which he was a failure. He never began a course without taking twenty drops of laudanum, and he read from a manuscript without daring to raise his eyes from the paper. In contrast to his brother who possessed marked oratorical ability and chose with care the exact word, John used the language of stable-boys. In speaking of syphilis, he exclaimed, 'I knocked down the disease with mercury and I killed it,' and in telling of a gunshot wound, he said 'the ball went into the man's belly and hit his guts such a damned thump, that they mortified.'

But altho it is agreed that he was not a success as a lecturer, it is nevertheless true that the most serious of his pupils derived considerable benefit from his instruction. For scribbled on scraps of paper in faulty spelling and shaky syntax were brilliant observations and far-reaching generalizations which could not be found in the most elaborate text-books of the day.

Then there was an open-mindedness about Hunter that

must have appealed to those of his students who relished independent thinking. 'Sir,' asked a pupil in surprise, 'did you not say the opposite of this last year?' 'Very likely I did,' was the answer, 'I hope I grow wiser every year.' 'Sir,' asked another pupil, 'had you not previously written—?' 'Never ask me,' replied Hunter, 'what I have said, or what I have written; but if you will ask me what my present opinions are, I will tell you.' 'Gentlemen,' said Hunter, when he saw his pupils taking notes, 'you had better not write down that observation, for very likely I shall think differently next year.'

Whatever may be said against this perplexing method of imparting knowledge, the fact remains that few teachers could point to such fruit as Hunter, for among his pupils were the foremost surgeons of the day: Astley Paston Cooper, John Abernethy, James Macartney, Anthony Carlisle, Henry Cline; John Thompson, author of the term 'varioid'; William Lynn, to whom Hunter once said when he was interrupted in his dissecting by a patient, 'Well, Lynn, I must go and earn this damned guinea, or I shall be sure to want it to-morrow'; Thomas Chevalier, the well-known Professor of Anatomy and Surgery at the Royal College of Surgeons; James Wilson, the first to describe the fasciculus of the compressor urethrae since known as Wilson's muscle; Edward Coleman, the cattle's physician, author of *Anatomy and Diseases of the Foot of the Horse*, the founder of scientific veterinary surgery in Great Britain; Guy of Chichester, John Kingston, and others. Americans, too, came to study under Hunter: there was William Shippen, the first to deliver a systematic course of lectures on surgery in this country, and one of the founders of the University of Pennsylvania; and then there was Philip Syng Physick, the father of American Surgery. Physick's father brought him to Hunter and asked what books his son would be expected to read. 'Sir,' said Hunter, 'follow me; I will show you the books your son has to study,' and leading the way to the dissecting-room, he

pointed to the corpses. But we have not yet named his greatest pupil and the best-beloved of all — Jenner.

As the mind of Hunter matured, his passion to study nature increased, and on the outskirts of London he managed to secure two acres which he populated with the inhabitants of rivers, mountains, jungles and deserts. These strange animals in the possession of another man would have constituted a circus, but under his observant eye they became an institute of natural history. On these grounds, sheep from Turkey and shawl-goats from the East Indies fed together, an ostrich pastured with buffaloes, and opossums and hedgehogs — which Jenner sent — looked at zebras and sniffed at the greedy jackal. In a pond were fishes, frogs, leeches, eels, mussels. Geese and ducks waddled around, bees and wasps were there in swarms, rabbits scampered to and fro, the air was a-flutter with pigeons, a whale was dissected, and an eagle sat alone in solitary grandeur. To learn its methods of self-defense Hunter wrestled with a beautiful young bull which the Queen gave him, and in one of these frolics he nearly lost his life. From an out-house two of his leopards broke loose, and when about to climb over the wall, were carried back to their dens by the bare hands of Hunter — a perilous procedure.

John Hunter was alive; his curiosity was limitless. To see something interesting he would travel anywhere, and to obtain it he would spend, beg, coax, cajole and threaten. 'Pray, George,' he said to his friend George Nicol the bookseller, 'have you got any money in your pocket?' 'I have.' 'Have you got five guineas? because if you have, and will lend it to me, you shall go halves.' 'Halves in what?' 'Why, halves in a magnificent tiger, which is now dying in Castle Street.'

'I am told,' he wrote to Jenner, 'there is a skin of a toad in Berkeley Castle that is of prodigious size. Let me know the truth of it, its dimensions, what bones are still in it, and if it can be stolen by some invisible being. I buried two

toads, last August a twelvemonth; I opened the grave last October and they were well and lively. Have you any queer fish? Write to me soon and let me have all the news.'

'Come, now,' said Hunter to Dr Clarke, 'I positively must have that preparation.' 'No, John Hunter, you positively shall not.' 'You will not give it to me, then?' 'No.' 'Will you sell it?' 'No.' 'Well then, take care I don't meet you with it in some dark lane at night, for if I do, I'll murder you to get it.'

One time Hunter was arguing to be allowed to perform a post-mortem examination; with his back to the fire, and his hands in his pockets, with his feet spread apart as if to balance his anxiety, he made an earnest figure. 'Then, sir,' he said at last, turning to the master of the house, 'you will not permit the examination to be made?' 'It is impossible.' 'Then, sir,' were the final words of Hunter, 'I heartily hope that yourself and all your family, nay, all your friends, may die of the same disease, and that no one may be able to afford any assistance.'

In Sir Joshua Reynolds' painting of John Hunter — that lifelike picture in which the rapt sitter seems able to break forth from the canvas at any moment — part of the background is formed by the feet of a skeleton of abnormal size. This was the skeleton of Charles O'Brien, the famous Irish giant. When the huge creature began to sicken, John Hunter cast longing eyes upon him. Hunter was a tireless worker, and for hours would stand motionless dissecting an insect in true Jan Swammerdam fashion, but after all it would be some satisfaction to trace nerves of magnitude, and to examine titanic muscles from broad origin to vast insertion. The giant learnt that Hunter had designs upon his carcass, and to escape the anatomist's scalpel he gave orders that when he died he should be placed in a leaden coffin and sunk into the sea. But the men whom the undertaker hired to watch the eight-foot corpse, watched also the opportunity to refresh their lesser but living bodies with liquor. Hunter's servant



HUNTER

discovered their favorite ale-house and informed his master, who came there immediately, met one of the party and offered him fifty pounds if he would allow the body to be kidnapped. The man said he must consult his companions, and returned saying that the bribe would have to be one hundred pounds. Hunter eagerly agreed, but the others were quick to perceive their advantage — no, they were not Jews, but sons of Erin, — and they kept on bargaining until finally they raised the demand to five hundred pounds. This was far more than Hunter could spare, but still less could he spare the giant's body, so he borrowed the money, and in the middle of the night the mortal remains of Charles O'Brien were conveyed to his residence, while a leaden coffin, weighted with paving stones, was sunk in deep water.

Among the many schemes that grew from Hunter's prolific brain none was greater than his idea to found a museum whose collections would illustrate all the functions of life. On the furtherance of this conception he spent much of his time and most of his money. When the Museum assumed colossal proportions, Hunter opened it for inspection during two months of the year — October for the profession, and May for 'the noblemen and gentlemen who are in town only during the spring.' So inconsistent is the genus homo, that altho Hunter sprang from the soil, and was a rough and ready fellow all his life, a blunt out-spoken man hating sham, he was nevertheless one of the staunchest of Tories. He used to say that he wished all the rascals who were dissatisfied with their country would be good enough to leave it. Hunter was an innovator in surgery, but he regarded with horror an innovator in politics. In reply to a request that he permit a certain foreigner to go thru his Museum, he wrote, 'If your friend is in London in October (and not a Democrat) he is welcome to see it; but I would rather see it in a blaze, like the Bastile, than show it to a Democrat, let his country be what it may.'

But we must see his magnificent collections, and since we

may not come in with the noblemen, and it is always uncertain who is a gentleman, we will enter as members of the profession. Perhaps we will be so fortunate as to meet Blumenbach or Scarpa there.

What specimens — thousands upon thousands — dry, in spirits, stuffed, — everything: varieties of the cuticle of different animals, showing how it increases in vascularity in proportion as its sensibility increases; the organs of taste, smell, hearing and sight, exhibited in ascending series. The individual peculiarities of plants and animals, monsters, mummies, the skulls of the five great divisions of the human race, the development of the brain and spinal marrow from the knotted cord of the crustacea upwards thru fishes, reptiles and birds, to the brain and spinal cord of the mammalia; teeth, from the beaks of birds to the tusks of boars; specimens showing the effects of various diseases on brains, hearts, lungs, stomachs, intestines, spleens, kidneys — the apotheosis of pathology.

But we have not yet seen the division illustrative of the function of reproduction. Here are preparations of the sexual organs in hermaphrodite plants, preparations of the organs in self-impregnating animals, and preparations of those animals which perform a double coitus. How nicely the series is arranged, first exhibiting the testes and penis in insects, then in several kinds of fishes, and numerous specimens of the testicle in the toad, showing how in the season of coupling it increases in size and is attended with an increase in the size of the tubercle of the thumb, which is employed in retaining the female. Next comes the double penis of snakes and lizards; we examine the crocodile and turtle and observe that in them it is single and begins to assume the general form which it exhibits in the mammalia; and so the specimens go on till they portray the virile organ of man. It is the shrine of Priapus.

Of course in this department are preparations of the female organs also — the pistils in plants, ovaries and ducts in

molluscos animals, and then all thru the scale up to the fully-developed genitalia of woman — and all the changes that occur in wombs, and the different ways in which ova are hatched, and the peculiarities of structure in the young animal during the fetal state, and the various modes in which food and protection are furnished for the young animal, as the temporary cells on the back of the pipa frog, the pouch of marsupial creatures, the nests that birds build, the glandular structure in the crop of pigeons which secretes a kind of milk, the lactiferous glands of the higher animals — and what not. The whole place is a hymn to Fecundity.

At the farthest end of the room a man is working. He is small, five feet two inches in height, but his short neck and broad shoulders give him an appearance of strength; he is dressed in a loose dissecting-apron, with the cuffs turned back; a single button holds the garment upon him. He is evidently one of the workmen around the place,—let us pass on. No, there is too much intensity in that face: it is John Hunter.

The phenomena of locomotion, digestion, absorption, circulation, respiration, etc., were illustrated in so comprehensive a fashion in the Hunterian Museum — beginning with the lowest plants and the smallest insects, and gradually leading up to the highest forms of organic life — that it is strange that the gifted founder did not hit upon the idea of Evolution. Before him lay the whole drama of development, he saw every organ in its primitive form and in its increasingly complex stages, but he did not anticipate the *Origin of Species*. Darwin quotes Hunter several times, and in the *Descent of Man* refers to him as ‘the illustrious Hunter,’ but he does not mention him as one of those who had an intimation of transformism.

But a study of Hunter’s writings does reveal at least one remarkable passage which proves that if he had pursued the subject further he would be reckoned among the precursors of the theory of natural selection. ‘It certainly may be laid down,’ wrote Hunter, ‘as one of the principles or laws of na-

ture to deviate under certain circumstances. It may also be observed that it is neither necessary, nor does it follow that all deviations from the original must be a falling off; it appears just the contrary; therefore we may suppose that nature is improving her works, or at least has established the principle of improvement in the body as well as in the mind.'

The Museum was Hunter's church, work was his religion,—and he had no other. He slept only four hours a night and napped for an hour after dinner, but all the rest of the twenty-four hours were spent in labor. If you asked for an appointment with him he was apt to tell you to meet him at five in the morning or earlier, and if you came at that hour you could find him already dissecting. 'Ah, John,' said old Dr Maxwell Garthshore, 'you are always at work!' 'I am,' was the answer, 'and when I am dead you will not soon meet with another John Hunter.'

He discovered much: he was forever experimenting. He had the privilege of making experiments on the deer in Richmond Park, and once he caught a buck and tied one of its external carotid arteries; he was not perplexed when the half-grown antler, which had received its blood-supply from the imprisoned vessel, became cold to the touch. But a week or two later, when the wound around the ligatured artery healed, Hunter again examined the antler and was surprised to observe that it had regained its warmth and was growing. Thinking that perhaps the artery had not been sufficiently bound, Hunter killed the buck to ascertain if this was really the case, but he had done his work well: he found that the external carotid was tightly secured. But he found also that certain small branches of the artery, both above and below the ligature, had enlarged and by their anastomoses had restored the blood-supply of the developing antler. 'Oho,' said Hunter, 'I see that under the stimulus of necessity the smaller arterial channels quickly increase in size to do the work of the larger. I must remember that.'

Not many months later there lay in St George's Hospital a

patient who was looked upon as doomed: either he would succumb to popliteal aneurism, or he would perish under the surgeon's knife, for few who underwent this operation lived to undergo anything else. So frequently fatal was this operation that the profession began to adopt Percival Pott's method — amputation of the limb above the tumor. But the physician in Hunter revolted against this idea of mutilating a man. He never regarded an operation a success if the patient rose from the operating-table a cripple. Hunter thought of his experiment with the buck — recalled that when the passage thru a main trunk is arrested, the collateral vessels are capable of continuing the circulation; if, he wondered, far from the seat of the disease he fettered the artery in the sound parts where it is tied when amputation is performed, would not the absorbants be able to cope with the tumor? So in the lower part of its course in the thigh, in the fibrous sheath since known as Hunter's Canal, he ligatured his patient's femoral artery. In six weeks the patient left the hospital, walking on the legs that Nature gave him and that Hunter saved for him. And following in his path, on healthy limbs, have trod thousands of men, rescued from deformity or death by this discovery of John Hunter.

Writing was a hardship to Hunter, and his friends had to be called in to correct his spelling and strengthen his grammar, but he left behind him a considerable list of publications. In 1767 he was elected a F. R. S. and he contributed many papers to the *Philosophical Transactions* of the Society. Among these valuable memoirs we may mention: *Anatomical Observations on the Torpedo*; *Observations on the Gillaroo Trout*; *An Account of the Gymnatus Electricus*; *Experiments on Animals and Vegetables with Respect to the Power of Producing Heat*; *Proposals for the Recovery of People Apparently Drowned*; *An Account of the Free Martin*; *Account of the Organ of Hearing in Fishes*; *Observations Tending to Show that the Wolf, Jackal and Dog are All of the same Species*; *An Experiment to Determine the Effect of Extirpat-*

ing one Ovarium upon the Number of Young Produced; Observations on the Structure and Economy of Whales; Observations on Bees; Observations on Fossil Bones. The modest titles of these essays do not suggest, even faintly, the scope of thought or the amount of experimentation that went into their making; for instance the paper on the Bees was the result of twenty years of the hardest thinking and the most careful kind of original research. All his books were of great importance: *A Treatise on the Natural History of the Human Teeth; A Treatise on the Venereal Disease; Observations on Certain Parts of the Animal Economy; A Treatise on the Blood, Inflammation, and Gunshot Wounds.*

Most of his books were printed in his own house by compositors in his own service. In adopting this plan Hunter evinced much wisdom, for he was an impatient hot-headed man afflicted with angina pectoris, and he would never have lasted long if he had permitted himself to be worried by the aggravating tribe of type-setters and book-binders.

It was in May 1771 that Hunter's first book appeared, and two months later he married Miss Anne Home, spending the proceeds of the publication upon the event, which indicates that it must have been a very modest wedding. He announced the news to William in the following letter:

'Dear Brother,—To-morrow morning at eight o'clock and at St James's Church I enter into the Holy State of Matrimony. As that is a ceremony which you are not particularly fond of, I will not make a point of having your company there. I propose going out of town for a few days; when I come to town I shall call upon you. Married or not married, ever yours, John Hunter.'

Hunter was forty-three at this time, his wife was twenty-nine. Anne was quite a personality—not a mere house-keeper. She was amiable and beautiful and clever; her poems were published in a volume. Her impassioned tribute to the memory of young Chatterton should be remembered by all who venerate the genius of that unfortunate poet who was

forced to slay himself at the age of seventeen, but whose name will never disappear from English literature. It was Mrs Hunter who supplied the words for Haydn's *Creation*, and she likewise furnished the verses for several of the Austrian composer's canzonets. As an example of her style, let us quote one of these pretty songs:

My mother bids me bind my hair
 With bands of rosy hue,
 Tie up my sleeves with ribbons rare,
 And lace my bodice blue.

For why, she cries, sit still and weep,
 While others dance and play?
 Alas! I scarce can go or creep,
 While Lubin is away.

'Tis sad to think the days are gone,
 When those we love were near;
 I sit upon this mossy stone,
 And sigh when none can hear.

And while I spin my flaxen thread,
 And sing my simple lay,
 The village seems asleep or dead,
 Now Lubin is away.

Ottley says Anne was 'a little of a *bas bleu*,' which is not so bad, however, as being *mauvais ton*. Ottley also relates this interesting domestic incident: 'Mrs Hunter was rather fond of gay society, a taste which occasionally interfered with her husband's more philosophic pursuits. On returning home late one evening, after a hard day's fag, Hunter unexpectedly found his drawing-room filled with musical professors, connoisseurs, and other idlers, whom Mrs Hunter had assembled. He was greatly irritated, and walking straight into the room, addressed the astonished guests pretty much in the following strain: 'I knew nothing of this kick-up, and I ought to have been informed of it beforehand, but as I am now returned home to study, I hope the present company will

retire.' Ottley adds that this intimation was speedily followed by an *exeunt omnes* — but he does not report what happened when the charming heroine and the irate villain were left alone.

There is in existence a letter by Anne Hunter, written at Bath, which is worth reading because it was addressed to Edward Jenner and because it exhibits John Hunter in repose:

'Dear Sir — I take it for granted you will not feel sorry to hear Mr Hunter is so near you, tho you will lament that loss of health is the occasion. He has been tormented with a flying gout since last March, and we are come here in hope of some favorable crisis before the winter. He has been inquiring for the post to Berkeley, and I find within this hour that it goes off this evening; as he is now asleep after dinner, I rather write myself than disturb his nap, to inform you of our being in your neighborhood, and that Mr Hunter will be glad to hear from you. I am, dear Sir, your obedient Servant, A. Hunter.'

We have given several instances of Hunter's hasty temper, but it must not be supposed that, like Thomas Carlyle, he was in perpetual ill-humor. He was naturally benevolent, and was beloved by those who were not jealous of him. He often returned a fee if he thought the patient could not afford payment, and when patients told him outright that they had not a shilling, he did not remind them there were other physicians in town. Frequently he would let his rich patients wait while he attended to the poor, saying that the grandees had nothing to do anyway, while to the poor, time was money. It is true, like most men he hated to be contradicted, but as his brother William said, this is a special characteristic of anatomists because they grow accustomed to the passive submission of dead bodies. Nor must it be forgotten that for years Hunter was a sick man; he toiled at his labors harder than the Titans piling mountains upon mountains, but a terrible ailment racked his body: not only did he suffer from

gout, but angina pectoris — that agonizing breast-pang which cramps the heart with excruciating pain — was ever ready to attack him. Had his health been better, no doubt he would have been less testy. Hunter well knew that it was dangerous for him to become choleric, and he used to say, ‘My life is in the hands of any rascal who chooses to annoy and tease me.’

One of these paroxysms was witnessed by his brother-in-law, Everard Home, who vividly describes his condition: ‘I was with him during the whole of this attack, and never saw anything equal to the agonies he suffered; and when he fainted away, I thought him dead. These affections at last seized him when lying in bed, and in his sleep, so as to waken him. The exercise that generally brought on the spasms was walking, especially on an ascent, either of stairs or rising ground; the affections of the mind that brought them on were principally anxiety or anger; the anxiety about the swarming of a hive of bees brought it on; the anxiety lest an animal should make its escape before he could get a gun to shoot it, brought it on; even the hearing of a story would bring it on; anger brought on the same complaint, and he could conceive it possible for that passion to be carried so far as totally to deprive him of life. But what was very extraordinary, the more tender passions of the mind did not produce it; he could relate a story which called up the finer feelings, as compassion, admiration for the action of gratitude in others, so as to make him shed tears: yet the spasm was not excited.’

In 1780 occurred the most lamentable and inexplicable episode in the lives of the illustrious brothers. John communicated to the Royal Society a paper on *The Structure of the Placenta*, which began, ‘The connexion between the mother and the fetus in the human subject has, in every age in which science has been cultivated, called forth the attention of the anatomist, the physiologist, and even the philosopher; but both that connexion, and the structure of the parts which form the connexion, were unknown until about the year 1754. The subject is certainly most interesting, and the discovery

important; and it is my intention, in the following pages, to give such an account of it as I hope may be acceptable to the public; while, at the same time, I establish my own claim to the discovery.'

In reply to this paper William wrote to the Society asserting that it was he who had made the discovery, and that it could be found in his *Anatomy of the Gravid Uterus*. John wrote again, reaffirming his claim, and furnished more particulars about the matter. The Royal Society was then requested to settle the honors between them, but the Council flatly refused to publish John's paper or to take any cognizance of the fraternal quarrel.

But what on earth had induced John Hunter to bring up again a sore subject more than a quarter of a century old? Because, said Gossip, he was angry at his brother who was angry at him because he married Miss Home. But the elusive and slippery facts we don't know, you don't know, nobody knows. Thus the brothers parted company; it was shameful, almost as scandalous as the action of John Bernoulli who expelled his son Daniel from the house because the young man won the prize of the French Academy which the father himself coveted.

Three years later William Hunter was severely ill, but against the advice of friends he insisted on attending his classes; during the lecture he began to die, but that well-trained voice delivered its sonorous sentences; the discourse ended, the doctor bowed to his students—and fainted from exhaustion. He was taken home, and in the night he was smitten with a paralytic stroke. When John heard of this, he knew it was time to swallow his pride, and he asked and received permission to visit William. So the brothers met again—but the elder lay on his death-bed. He died as gracefully as he lived. 'If I had strength enough to hold a pen,' were his last words, 'I would write how easy and pleasant a thing it is to die.' On Sunday, March 30, 1783, in the sixty-fifth year of his age, he passed away. John was not men-

tioned in the will — not even the old homestead of Long Calderwood was left to him.

Ten years later John Hunter himself was sixty-five years old. He was a distinguished man: Fellow of the Royal Society, Member of the Irish College of Surgeons, Member of the Chirurgo-Physical Society of Edinburgh, Surgeon-General to the Army, Inspector-General of Hospitals, Surgeon to St George's Hospital, Surgeon-Extraordinary to the King, etc., etc. On no occasion, however, did he append any of these useless titles to his name; in all his writings he proudly signed himself — John Hunter.

For the last twenty-five years he was on the staff of St George's Hospital. The reason he served so long was because his colleagues couldn't oust him. They could never get along with Hunter, and they did not see why he received more pupils than they did, and besides they wanted to know what business had a surgeon to waste so much time in physiological researches. 'His museum,' remarked one of his associates, 'is of as much use as so many pigs' pettitoes.' And Hunter was not biblical, and did not believe in the soft answer that turneth away wrath.

Disputes developed, angry letters were written back and forth, and often the Governors were asked to interfere, and they did so by uniformly deciding against Hunter — a circumstance which did not tend to make him imitate a turtle-dove. He was of an imperious nature, and his high spirit chafed under his defeats.

In the early autumn of 1793 his colleagues adopted a resolution: no pupil could be received into the hospital unless he had a certificate proving that he had been bred up to the profession. This was considered a slap at Hunter, who was no stickler for such things, and would accept all pupils who seemed promising, even if they lacked previous education: perhaps he remembered his own case. Not long after this rule went into effect, two young men without certificates came to Hunter and asked to be admitted under him at the hos-

pital. 'I'm sorry,' said Hunter, 'but — well, suppose you write out your case; to-morrow we have a meeting of the Board, and I'll do what I can for you. Perhaps they'll let you in.'

On the morrow Hunter was in admirable humor. He was growing old and was somewhat of an invalid, but his hand had not lost its cunning: that morning he had made a dandy dissection — just what he needed for the museum. He radiated good cheer. He strode into the work-rooms and told his resident-pupils some funny stories how children counterfeited illness — for certain purposes. His pupils laughed.

Hunter was so pleased with himself that he forgot to take his visiting-list along when he left his home — whistling a Scotch air as he went. But William Clift, the Cornish lad who idolized Hunter, saw that York Street was the first place on the list and he ran there with the day's schedule. He found Hunter's carriage waiting, and soon Hunter himself came out of the house. Clift handed him the record of appointments, Hunter took it, looked it over, and in a ringing voice told the coachman to drive to the hospital.

He entered. The meeting had already begun; Hunter sat down; he spoke in behalf of the young men. Instantly a colleague opposed him. Choking with pain and rage John Hunter arose; he turned toward the next room, and Dr Robertson and Matthew Baillie followed him; Hunter uttered a groan and staggered into Dr Robertson's arms. Everard Home, who was in the hospital, was sent for. Hoping that he had only fainted, they worked upon him for over an hour; but life had fled. He was murdered by an insult — with the aid of angina pectoris. The visiting-list was in his pocket, but the remainder of his appointments were cancelled. The Board broke up, inserting the following notice in its minutes:

'Resolved — That Mr Hunter's letter to this Board relating to two of the surgeon's pupils, which was received this day, be preserved for future consideration.'

The feet of horses were heard in Leicester Fields; Mrs Hunter looked out of her window and saw an empty carriage.

She much desired that her husband repose in Westminster Abbey, but it was not to be; he was interred in St Martin's-in-the-Fields. Long afterwards she composed to his memory an Epitaph:

Here rests in awful silence, cold and still,
One whom no common sparks of genius fired;
Whose reach of thought Nature alone could fill,
Whose deep research the love of Truth inspired.

Hunter! if years of toil and watchful care,
If the vast labors of a powerful mind
To soothe the ills humanity must share,
Deserve the grateful plaudits of mankind —

Then be each human weakness buried here
Envy would raise to dim a name so bright:
Those specks which in the orbs of day appear,
Take nothing from his warm and welcome light.

By the terms of the will, his nephew, Dr. Matthew Baillie — the last medical man in London who carried the famous gold-headed cane — and his brother-in-law, Sir Everard Home, were appointed executors. After the elapse of some years Home insisted on having all of Hunter's unpublished manuscripts — he said he needed them to prepare the Catalog of the Hunterian Museum — and William Clift who had guarded them so faithfully put them in a cart and conveyed them to Sir Everard.

Men began to speak of the greatness of Everard Home. He contributed more papers to the Royal Society than any other member, and these communications were remarkable for their breadth of vision and for the number of discoveries they contained. 'He inherits the mantle of John Hunter,' they said.

The trustees of the museum grumbled; they urged Home to get the Catalog ready; it was more than time. 'If you are too busy with your important researches,' they suggested,

‘let someone else do it.’ ‘Nonsense,’ answered Sir Everard, ‘I will prepare the Catalog myself.’ And the ambitious investigator kept on reading papers before the Royal Society, and men said of him, ‘He is a second John Hunter.’

In July 1823 Everard Home received from the printer the last proof of his concluding volume of *Lectures on Comparative Anatomy*. Sir Everard was ageing, and knew that death might take him unawares, but as he did not wish men to know that for years he had been stealing from John Hunter’s manuscripts, he placed these priceless papers upon his hearth. Flames leaped up the chimney; so much smoke was made that the engines came, and firemen demanded entrance; but Modred calmed them: the house was not on fire — it was only John Hunter’s manuscripts burning.

The case came to court, and Sir Everard defended himself by saying that Hunter had commanded him to destroy the manuscripts as they were in too imperfect a form for the public. Among those who tried to testify against Sir Everard was poor Clift — but he broke down and cried.

But William Clift had done a deed that makes posterity bless his name. During the period that this devoted boy had access to the manuscripts, he frequently read and made extracts from them — with his own hand he copied nine folios. And many years later, his son-in-law, the distinguished Sir Richard Owen, edited these notes in two volumes, entitled, *John Hunter’s Essays and Observations on Natural History, Anatomy, Physiology, Psychology, and Geology* — and even Darwin quoted from them.

As the years rolled by, the British nation awoke to the fact that the fitting resting-place of so great a man as Hunter was Westminster Abbey. But his body had long lain in the vaults of St Martin’s-in-the-Fields. Who could locate his coffin among thousands? ‘I will find it,’ said Frank Buckland. He spent sixteen days in the charnel-house, examined over three thousand coffins — and found it. With more honor than he ever received during his lifetime, John Hunter

was buried in the North aisle of the great Abbey, and on perennial brass were inscribed the words, The Founder of Scientific Surgery. This aisle is a veritable shrine of science, for besides John Hunter it now contains the remains of Newton, Darwin, Herschel, Lyell, Woodward, Mead, Couch Adams and James Prescott Joule. The wishes of John Hunter's widow were at last fulfilled, but she never knew it: so many good things in this world come too late.

The fame of Hunter has increased with the passing of the years. Every Hunterian Oration is eloquent — as eloquent as the orator can make it — in praise of his genius, and Samuel D. Gross has left this line on record: 'With the exception of Hippocrates, the father of Medicine, John Hunter is the grandest figure in the history of our profession.'

The Life of Hunter has been written several times: pathologically by Everard Home, cleverly but maliciously by Jesse Foot, eulogistically by Joseph Adams, colorlessly by Stephen Paget, more satisfactorily by Drewry Ottley, but the only adequate sketch of his mental career occurs in Henry Thomas Buckle's *History of Civilization*.

It must not be thought, however, that we believe in the chasm which Buckle imagines to exist between the deductive and inductive method. According to Buckle, the Scotch are the most deductive people on earth, while the English are the most inductive, and therefore, he argues, since Hunter spent the first twenty years of his life in a deductive country and the remainder in an eminently inductive nation, it follows that the two hostile forces of deduction and induction struggled for the mastery in his mind and at times obscured his understanding.

We can answer this argument with an incident from the historian's own life: When Buckle was a chess-player he occasionally met in the cigar-divan of the Strand a youth of his own age. Some years later this young man decided to publish a series of books by subscription, and Buckle was among the first subscribers. If Buckle had not died in his prime he

would have received the volumes of the *Synthetic Philosophy*, beyond all peradventure the vastest deductive work ever conceived — but generated and accomplished, not in a Scotch, but in an English brain.

This then is the stricture that we would pass on Buckle's examination of Hunter's intellect, but in all other respects we pronounce it a far abler and more comprehensive sketch than has been written by any medical man; the passage on Hunter as a pathologist is especially superb.

Among the speculations which had engaged Hunter's mind was the possibility of scientifically freezing human beings, and warming them back to life a century or two afterwards. But tho he pursued the subject so far as actually to experiment on animals with this object in view, his ingenious project, like Leonardo da Vinci's ambitious plan to remove mountains by the laws of physics, never materialized. On the whole we need not regret that he failed in this respect, for it is with considerable trepidation that we would view the re-birth of some of Hunter's contemporaries; for instance, Samuel Johnson, the arch-obscurantist, nor would we care to listen again to Edmund Burke's puerile lament of mankind's ingratitude towards queens.

But how well it would have been if John Hunter himself, instead of perishing in a passion, had been congealed, and if now, after an hibernation of 120 years, he could be thawed out and live once more among us. How eagerly we would press around the master, and how much his disciples would have to show him. But not long could we prattle, for John Hunter would grow impatient, and we would soon see him lost in thought, as when he sat before Sir Joshua's brush, or we would find him with rolled-up sleeves in a laboratory, working over the great modern problem of cancer.

(1749-1823)

JENNER AND VACCINATION

JENNER AND VACCINATION

Medicine has never before produced any single improvement of such utility. Harvey's discovery of the circulation of the blood was a beautiful addition to our knowledge of the ancient economy; but on a review of the practice of medicine before and since that epoch, I do not see any great amelioration which has been derived from that discovery. You have erased from the calendar of human afflictions one of its greatest. Yours is the comfortable reflection that mankind can never forget that you have lived; future nations will know by history only that the loathsome small-pox has existed, and by you has been extirpated.

THOMAS JEFFERSON: *to Edward Jenner.*

LET us not mourn at the mystery which surrounds the life of Mary Wortley Montagu, for altho it is true that we cannot ascertain whether the honorable lady ever entered a harem and saw the Sultan's animated aphrodisiacs, it is equally true that the matter is of no consequence, while what we do know of her is of the utmost importance: that during the second decade of the eighteenth century, while residing at Constantinople in the capacity of the British Ambassador's wife, she observed the Turkish practice of inoculating against smallpox.

Most Englishwomen of that period would have scorned to adopt the ways of the heathen, but Lady Mary had eloped from the parental home, and a woman who elopes is apt to be unprejudiced. The chief fault of such women is that twenty years later they object to their daughters following in their flying footsteps.

In one of those gossipy letters which have gained her a place in literature by the side of Madame Sevigné, Lady Mary writes: 'I am going to tell you a thing that I am sure will make you wish yourself here. The smallpox, so fatal, and so general amongst us, is here entirely harmless by the invention of ingrafting, which is the term they give it. There is a set of old women who make it their business to perform the

operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the smallpox; they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nut-shell full of the matter of the best sort of smallpox, and asks what veins you please to have opened. She immediately rips open that you offer to her with a large needle (which gives you no more pain than a common scratch), and puts into the vein as much venom as can lie upon the head of her needle, and after binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. The Grecians have commonly the superstition of opening one in the middle of the forehead, in each arm, and on the breast, to mark the sign of the cross; but this has a very ill effect, all these wounds leaving little scars, and is not done by those that are not superstitious, who choose to have them in the legs, or that part of the arm that is concealed. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. Every year thousands undergo this operation; and the French ambassador says pleasantly, that they take the smallpox here by way of diversion, as they take the waters in other countries. There is no example of anyone that has died in it; and you may believe I am very well satisfied of the safety of this experiment, since I intend to try it on my dear little son.'

Oddly enough, the recipient of this information, Miss Sarah Chiswell, later succumbed to the smallpox — and yet not so oddly for in those days to die from smallpox was almost the natural manner of dying. The 'dear little son' in the case was duly and successfully inoculated, and lived — to become a big scoundrel.

On her return to England in 1722, Lady Mary introduced inoculation by submitting her daughter to the test. The vi-

vacious authoress complained she would like to communicate with the physicians on this topic if she knew any 'who had virtue enough to destroy such a considerable branch of their revenue for the good of mankind,' but her first disciple was a physician: Dr Keith of London, who also inoculated his own daughter. From that time on, the practice of inoculation came into vogue in England.

But this production of a modified form of smallpox in order to secure exemption from a more malignant attack, proved to be only a mixed blessing at best, for the inoculated person became a source of danger to his unprotected neighbor. The inoculated smallpox was fully as infectious as the natural variola, and while it conferred immunity on those who availed themselves of the practice,—tho often with more suffering than Lady Mary's letter would lead us to suppose—it spread the disease to great numbers who had not been inoculated. So while with one hand it did good, with the other it committed evil; it saved the individual and menaced the community. Mankind felt that a better prophylactic must be discovered before it could cease to consider the smallpox the worst of diseases.

When Lady Mary passed out of this world, venerable now and white-haired, a lively little fellow of about twelve was always willing to exhibit his collection of dormouse's nests—all found by himself among the bushes—but this did not mean that he was certain to be a great scientist, for childhood is naturally curious, and every boy who experiments in catching flies, or breaks an egg-shell to see why the chicken doesn't come out, does not develop into a Lamarck or an Hilaire. Some of them become politicians, and are averse to all investigation.

Youthful Edward Jenner had none of the eccentricities of genius. He did not muse, mope, or argue with his nurse in Greek to convince her that he was precocious. He was not like the babe Macaulay who smoothed his bib and said, 'Mamma, industry is my bread, and attention my butter.'

On his second birthday he did not inquire what was the purpose of life, and there was nothing to distinguish him from the other lads of Gloucestershire.

When he grew older, he learnt the lure of apparel, and ornamented himself with a blue coat and yellow buttons, the sprucest buckskins in the market, well-polished jockey-boots whose silver spurs he often clanked together, a handsome whip that smacked the air with a whizzing sound, and when he removed his broad-brimmed hat he revealed his hair stylishly done up in a club.

He was fond of society, being a favorite in it. Not only was he a good-natured and animated companion, but he possessed those accomplishments which are immediate passports of admittance to the shrine of conviviality: he could perform on the violin and the flute, and when properly urged by the ladies he would warble songs that he had written himself. His biographer assures us that these verses were very good, but he makes the mistake of printing some of them, by which we see that they were only fairish.

His biographer further assures us that Jenner never played cards, and while this may be a fact — as he was the son of a clergyman — we must accept the statement with suspicion, for biographers have the bad habit of attempting to make their heroes too respectable. The more we learn of famous men, the more do we see that they did not scorn what is colloquially known as ‘having a good time.’ Gibbon was gay in Paris, and when Darwin was a student at Cambridge he sometimes drank too much. ‘I know,’ says the author of *Origin of Species*, ‘I ought to feel ashamed of days and evenings thus spent, but as some of my friends were very pleasant, and we were all in the highest spirits, I cannot help looking back to these times with much pleasure.’ The average freshman might quote the above words in explaining to his father why his acquaintance with the college curriculum was not more intimate.

As mentioned above, Jenner was the son of a clergyman,

and his mother was a clergyman's daughter before she became a clergyman's wife; her brothers were clergymen, and almost all his sisters married clergymen, and nearly all their children became clergymen, but in spite of this alarming situation, Edward Jenner manifested an inclination for the natural sciences — perhaps his collections of nests and fossils meant something after all — and he was sent to Sodbury, near Bristol, to learn surgery and pharmacy under the preceptorship of Daniel Ludlow.

While Jenner was working for Ludlow, a country-girl came there for treatment. Smallpox was mentioned in her presence, to which she replied, 'I cannot take that disease, for I have had cowpox.' The young apprentice happened to be in the room at the time, and pricked up his ears with interest. He recalled that the farmers and dairy-maids of Gloucestershire had the same notion. The next day, while running an errand for his master, he found himself thinking on the topic.

That Jenner had the scientific spirit is evident from an incident which occurred long before the chemist of Heidelberg invented the Bunsen burner: a discussion arose whether the temperature of a candle is higher in the center of a flame or at a small distance from its apex. Instead of indulging in theory, Jenner drew the candle towards him, and inserted his finger in the middle of the flame, keeping it there for some seconds. He then placed it a little above the flame, but was immediately compelled to withdraw it. He thus solved the problem in a manner that would have delighted John Hunter, whose everlasting query was, 'Why not make the experiment?'

In 1770, being then in his twenty-first year, Jenner arrived in London, where he became the favorite pupil of the illustrious teacher to whom we have just referred. The following year Captain Cook returned from his first voyage of discovery, his ships loaded with specimens collected by Sir Joseph Banks. Hunter was asked to name someone who could arrange and classify this museum of natural history,

and he recommended his pupil. With such skill did Jenner perform his work that he was asked to accompany the next expedition as naturalist.

What an opportunity for a youth of twenty-two: to sail around the world in the interests of science; to enter unknown waters and give names to unexplored territory; to gaze upon strange faces, and collect fossils in islands previously undisturbed by the European; to penetrate for the first time a virgin forest, and chase a wild animal over sands that never knew a human footprint. Such prospects have made older scientists sleepless with enthusiasm, but Edward Jenner would not go. He was neither adventuresome nor ambitious, he wished to return to the rural scenes of his childhood, and above all he was unwilling to be separated from his eldest brother. The phrase, 'they loved each other like brothers,' is often received with derision, but Edward Jenner and Stephen Jenner proved that brothers can love.

Jenner settled in Gloucestershire, in the shady vale of Berkeley, to prescribe tartar emetic to the neighboring farmers. But John Hunter did not permit him to lead the life of the ordinary village doctor. 'I want,' wrote Hunter in a series of letters, 'a salmon that has just spawned; I will take a cock salmon when you please. . . . Let me have some bats; try some yourself, open a hole in the belly, and observe the heat there, and the fluidity of the blood, also see if you can catch the number of pulsations and the frequency of breathing in the bat. . . . I thank you for your experiments on the hedge-hog; but why do you ask me a question by way of solving it? I think your solution is just; but why think—why not try the experiment? . . . What do you think of examining eels? Their sexes have not yet been found out, nor their mode of propagation; it is a thing of consequence in Natural History. . . . Next spring I would have you make experiments upon the growth of vegetables, and if you have no objection, I will set you upon a set of experiments dealing with the heat of vegetables



JENNER

in the winter. If in any of these pursuits you discover any principle worthy the public, I will give it into the Royal Society for you. . . . I received your account of your experiments on the hedge-hog, also the dog-fish, for which I thank you. I have now received your account of the aneurismal vein with the cast, and I showed it to my pupils this evening with the description. I hope you will be able to procure the arm when the man dies. . . . If a good deal of that air of the hog's guts could be collected, see if a candle will burn in it as large as in common air. . . . What are you doing? how do hedge-hogs go on?' Jenner was fond of this research work, and on his own initiative started out to solve the interesting problem why it is that the cuckoo lays its eggs in another bird's nest.

But all the while he bore in mind the reputed prophylactic power of the cowpox, and listened to the gossip of cowherds as if he were an antiquarian collecting the folk-lore of a disappearing race. Year after year, with remarkable patience, he investigated every phase of the distemper. The disease in the cow was mild, and the disease in man was virulent, so Jenner thought it would be a great thing if cowpox could be transferred to the human subject for the purpose of modifying the terrible smallpox. One attack of smallpox usually exhausted the susceptibility of the constitution to a second attack — the same as scarlet fever or measles — and since, argued Jenner, the cowpox is only a benign form of smallpox, why not introduce the cowpox virus into the system of man and thereby save him from the malignant type?

To read text-books is easy — if they are written with a certain respect for grammar — but to do research work is to grapple inch by inch with the obscure, and battle step by step with the unknown. Jenner found his path beset with difficulties that would have turned aside any man who was not a genuine scientist. He found that cows were subject to a variety of eruptions on their teats, all of which were capable of producing sores on the hands of the milkers, but that only

certain of these sores afforded the system protection against smallpox. The distinction of true cowpox from spurious cowpox, by explaining why cowpox sometimes failed to prevent smallpox, was a decided step forward. But when further investigation revealed to Jenner that some individuals who had been infected with what he himself termed true cowpox, later caught smallpox, he was in that uncomfortable condition of mind which only John Hunter enjoyed: puzzled. Tackling the matter again, he was rewarded by the important discovery that the virus of true cowpox is subject to deterioration, and that only during a certain stage does it possess the virtue of protecting the human system against the invasion of smallpox.

To save the face of mankind from the papule, vesicle, pustule and crust, became the engrossing purpose of Edward Jenner's life. At a medical society to which he belonged he persisted in speaking of the protective power of the cowpox so continually that the other members felt bored and threatened him with expulsion.

His confrères were much better pleased with him when they found him exhibiting interest in a subject which was beyond doubt: a maiden. Some of his friends recalled and quoted a proverb current since medieval times: 'From smallpox and love but few remain free.' Thereupon — altho it was not yet written — Jenner illustrated that chapter of Darwin's, which begins, 'Blushing is the most peculiar and the most human of all expressions.'

The lover was embarrassed at the raillery, but not displeased. There is something agreeable in being bantered by your friends about your sweetheart. Nothing is plain and direct, everything must be astute. The suppressed laughter and the pretended innocence are replete with expressiveness, while the clearing of the throat, the arching of the eyebrow, and the shrugging of the shoulder are charged with a mystic significance. It is all so delightfully suggestive; the charm of badinage consists in its subtility: a wink speaks a volume, and

a h'm means a treatise. The parties must be in sympathetic relations, *en rapport* as it were, otherwise there can be no delicate play or psychic interchange. In short, teasing is a fine art.

Of course, in such affairs, friends are always more certain of the outcome than the lover himself. Jenner's friends, for instance, were sure he was going to marry, but the lady in the case was sure he wasn't, for when he proposed, she answered, 'No, sir, but thank you just the same.' The world no longer remembers her, for by refusing to become Jenner's wife she lost her opportunity of having her name in the *Encyclopædia Britannica*.

The matter has never been satisfactorily explained, but it seems women do not take kindly to unusual men — with the exception of Byron. Every bar-room brawler relates his conquests of femininity by the hour, and the clerk, the book-keeper, and the mechanic — if only he have a starched dicky and a spangled vest wherewith to shine — exhibits trophies that Herbert Spencer could never have obtained. A nobody marries Beatrice and demands his slippers, and a nonentity becomes the lord of Laura and grumbles about his food, while a Dante and a Petrarch must worship these ladies from afar. It took Madame Hanska many years to decide whether she was willing to marry Balzac, and John Keats could get no satisfaction from Fanny Brawne, while any traveling salesman whose tie matches his socks, could have carried off the girl in three weeks. Goffredo Mameli's love was not returned, and Miss Aloysia Weber said 'Never!' to Mozart — and meant it.

Montaigne's famous 'pillow of doubt' was soft indeed when compared to the pillow of unreturned love on which Edward Jenner now lay. 'Never mind,' wrote John Hunter, 'let her go. I shall employ you with hedge-hogs.' It was fortunate for Hunter that he was Hunter, otherwise he would have received a wrathful reply, for to a youth in a sentimental mood nothing is so distasteful as humor. Jenner was really

disappointed, and as is natural at such junctures, contemplated suicide, and as is also natural, did not commit it. But many years were to pass before he forgot his first flame, for unlike the average male, Jenner was not an expert in the art of transferring his affections. Neither could he draw any relief from the popular adage, 'There is as good fish in the sea as ever was caught.'

Yet Father Time, a greater physician than even Hippocrates, gradually healed his wounds, and precisely when his friends were convinced that he was going to remain a bachelor, Jenner again felt the glorious spring-time stir within him. On this propitious occasion his feelings were reciprocated, and at the proper time a happy Yes faltered from the lips of Miss Catherine Kingscote, who is described as possessing elegant manners and other virtues. How Jenner would have fared with his first lady-love we cannot say, but we know that his long married life with Catherine was ideal from first to last, which proves that a man should never commit suicide when he is rejected only once.

Along the road that runs between Gloucester and Bristol, two companions were riding, engaged in conversation. The earnestness with which the elder spoke of exterminating small-pox revealed his identity. 'Gardner,' said Jenner, 'I have entrusted a most important matter to you, which I firmly believe will prove of essential benefit to the human race. I know you, and should not wish what I have stated to be brought into conversation; for should anything untoward turn up in my experiments, I should be made, particularly by my medical brethren, the subject of ridicule — for I am the mark they all shoot at.'

As the solution of the great problem grew nearer and nearer, the inner life of Jenner became intense. He rambled thru the meadows, near the ancient ruined castle of Berkeley, silent and alone, but the frequent flashing of his eye disclosed the fire that was burning within him, and the involuntary raising of his hand, as if he stood in the presence of some-

thing sacred, indicated that he was overpowered with emotion.

It is not difficult to understand his excitement if we invoke the ghost of smallpox that terrorized our forefathers. For centuries smallpox was the vastest horror that plagued the human race. At the tables of man no other evil and unwelcome guest was so familiar and so dreaded. During that long period no mother counted her children till all had passed thru smallpox. In those days the young men sighed, 'Oh, for a mistress who is not pock-marked!'

From its ravages no one was safe. It granted no favor to the old, it smote the middle-aged, it struck down the young, it scarred the babe in the womb. None were so lowly as to be passed by without notice, none so powerful as to enjoy immunity. Not only did it stalk thru the narrow alley, but it walked abroad on the boulevard. It lay on the toiler's cot of straw, and parted the purple curtains of the emperor's bedstead. Long before socialism was heard of, smallpox proclaimed, 'Special privileges to none.'

Elfrida, Alfred's daughter, the wife of Baldwin the Bald, was attacked by smallpox, and her grandson succumbed to the malady. It touched the fifteenth Louis of France, and the king rolled from his throne to the grave. It maimed and crippled William the Third of England, and ended the life of his young and beautiful Queen. On the same day it ordered coffins for Mary in the almshouse and Mary in the palace — pauper-woman and royal-lady equally speckled with pock-holes.

If Iwan Bloch is correct in assuming that syphilis had its origin in America and was introduced into Europe by the crew of Columbus, we may ask if it is not unfortunate that America was ever discovered. The licentiousness of imperial Rome in the fifth century was followed by the invasions of Huns and Vandals, but the libertinism of southern Europe in the fifteenth century was followed by the worse invasions of chancres and tertiary lesions. But certainly the pale-faces

had no ground for complaint, for tho the Indian women may have surprised the Spaniards with a new disease, the gallant dons squared up matters by bringing to America the scourge of smallpox.

When smallpox conquered America, the empire of the monarch of diseases was universal. No corner of the earth was now safe from the pock-mark. Everywhere it excited a common terror that made the whole world kin. With swift feet that traveled from household to household, with many-fingered hands that clutched the passer-by, with its impalpable poison carried by the atmosphere, and blown abroad by the winds, smallpox seemed like an eternal biblical curse.

Falling upon the natives of Mexico, it destroyed six million inhabitants with the same fury that it had decimated China in the pre-Christian era. The naked savage squatting on the equator, and the fur-clad Eskimo of the arctic circle, were equally apprehensive of its approach. It entered uninvited the wigwams that dotted our western prairies, and made itself at home among the straw-thatched huts of the African. It thinned the population of Ceylon, and in many districts of Iceland there were not sufficient survivors to bury the dead.

In the course of ages, the human race accumulated such fear of the eruptive fever that when the epidemic swooped upon the crowded communities of civilization there were times when sick infants cried in vain for mothers who had fled. When its pimpled visage appeared in the untamed forest an Indian father would call his family together, speak to them of the evil spirit which was torturing the tribes, and pointing to the dehumanized features of those already attacked, would exhort his children to escape a similar fate by falling upon their own daggers, promising them if they lacked the courage that he himself as a last proof of his devotion would do the deed of mercy, and at once follow them to the happier land.

'Smallpox,' wrote Macaulay, in the fourth volume of his *History of England*, 'was then the most terrible of all the

ministers of death. The havoc of the plague was far more rapid: but the plague visited our shores only once or twice within living memory; and the smallpox was always present, filling the churchyards with corpses, tormenting with constant fears all whom it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover.'

But it is unnecessary to exhaust our vocabulary, or to quote eminent historians, when the plain Arabic numerals are more eloquent. In preceding centuries, about 10 per cent. of all deaths were attributable to smallpox. In the single year 1796, the smallpox carried off 30,000 of Prussia's inhabitants, and about the same number were annually destroyed in France. Iceland was invaded in 1707 by smallpox which caused in that one year the loss of 18,000 out of a population of 50,000. In regions as widely separated as Brazil and Kamschatka whole races of men became extinct thru the fearful fatality of this disease. Sir Alexander Crichton calculated that annually every seventh child born in Russia died of smallpox. Bernoulli figured that every twenty-five years it deprived not fewer than 15,000,000 human beings of life. These numbers correspond to the estimation that has been made that in the eighteenth century alone smallpox killed at least 60,000,000 men, women, and children. Death statistics, however, tell only a portion of the damage done, for millions of the so-called survivors, weakened, crippled, sightless, became subject to half the pathologic terms found in a medical dictionary.

In those stricken days, if a messenger had come from heaven, and standing on earth's highest hill had clarioned to all mortals, 'From the long roll of human evils I shall remove one disease: which shall it be?'—one universal voice would have ascended in answer, the desire of kings blending with the prayer of peasants, the cultured accents of the

scholar mingling with the cry of the man of the streets: 'Smallpox!'

And now a humble village doctor expected to conquer this monster by a bit of virus on the point of an ivory lancet.

A dairy-maid named Sarah Nelmes, who had been pricked by a thorn, and become infected with cowpox while milking her master's kine, was his medium. On the fourteenth of May, 1796, Jenner took matter from her hand and inserted it by two superficial incisions into the arm of James Phipps, a healthy boy of eight. This was the first vaccination. On the first of the following July virulent smallpox matter that would have killed any unprotected lad in the world was introduced into this arm, but without the slightest effect, for Phipps had been vaccinated! This was the crucial experiment.

The vaccine virus could be passed from one human being to another; it was safe in itself, and endangered no one by contagion; the experimentation of twenty-five years was over; the problems were solved and ready for publication; a gate of death was closing — smallpox would become a disease of the past. That day the gossips of Berkeley who lingered by the village pump greeted Jenner as he passed, but did not know that their fellow-townsmen had made the world a safer habitation for the race of man.

The printer now became an important personage, and when all matters were arranged, a quarto of about seventy pages appeared, *An Inquiry into the Causes and Effects of Variolae Vaccinae*. This was the name which Jenner had given to the cowpox to indicate that he regarded it merely a variety of the variola, modified by passing thru the bovine species. The quarto contained an engraving of the hand of Sarah Nelmes, showing the position and development of the pustules. It is a rather delicate hand, with tapering feminine fingers. Were it not for the pustulous sores on it, a poet might write a sonnet to this hand — the hand that helped to halt a plague.

The first enthusiast in the cause of vaccination seems to have been the surgeon Henry Cline, who urged Jenner to

come to London immediately, painting in glowing colors the future that awaited him. But Jenner was now fifty years of age, and peaceful Berkeley was good enough for him. Prospects of gold and glory could not lure him to the Strand. He wrote to Cline that even in the morning of his days he had sought the lowly and sequestered paths of life, the valley and not the mountain, and now the evening was fast approaching, and he would not hold himself up as an object for fortune and for fame.

But when his nephew George, who was in London at the time, informed him that a person named Pearson was pushing himself forward as the chief agent of vaccination, but knew so little of the whole subject that he distributed virus contaminated with smallpox, Jenner was aroused. When he further learnt that Dr Pearson had secretly organized an institution for vaccine inoculation, and when that enterprising gentleman had the effrontery to offer him the position of extra-corresponding physician, Jenner said, 'Catherine, where is that valise of mine?'

Jenner hurried to London, and induced Lord Egremont and the Duke of York to withdraw their patronage from Pearson's institution. The modern Icarus found he had soared too near the sun, for his waxen wings melted, and he was drowned in the sea of obloquy.

It was inevitable that vaccination should arouse antagonism, both from the profession and the laity. Of course one clergyman declared that the practice was as old as the Bible, and the reason Job had so many boils was because the Devil had vaccinated him, while another preacher solemnly assured his parishioners that God sent smallpox into the world because Adam and his wife liked pippins. Dr Moseley claimed that communication with beasts might corrupt the mind and excite incongruous passions; while William Rowley, who seemed to believe in clinical demonstrations, exhibited a boy with a swollen face at one of his lectures, and explained the case as follows: 'On this cheek you plainly perceive a pro-

tubercle arising like a sprouting horn; another corresponding one will shortly spring up on the other side; for this boy is gradually losing human lineaments and his countenance is transmuting into the visage of a cow.'

But anyone conversant with the History of Medicine, who contemplates for a moment the reception of other medical discoveries, is astonished, not at the opposition which vaccination engendered, but that the opposition was so slight and cursory. Smallpox was so terrible, that vaccination was given a trial, and in hamlet and metropolis its beneficial effects were immediate. The ivory lancet was a magic wand which checked the approach of the epidemic. The medical dream of a Diseaseless Future moved one notch nearer its realization.

To say that vaccination spread like a new gospel would not express the situation, for even the most prevalent religions are limited by geographical lines. Whether a child grows up to be a Nirvana-loving Buddhist, or a votary of Voodooism; whether he is to be a Baptist and consider immersion essential to salvation, or a Catholic and evade the butcher on Friday; whether he follows Confucius, or swears that Mahomet is the prophet; whether he is to weep for Jerusalem in a Jewish synagogue, or believes that the Mormon God commanded Joseph Smith to love several women simultaneously, depends very much on the longitude of his birthplace and the theological proclivities of his nurse.

But vaccination overrode all boundaries and mixed with all men. A British ship sailed from Portsmouth to Gibraltar, and vaccinated the soldiers of the garrison. Dr Marshall vaccinated his own children and then introduced the practice into Naples and Palermo, where the superstitious inhabitants declared it 'a blessing sent from Heaven, tho discovered by one heretic and practised by another.' Dr John Walker vaccinated Abercrombie's army in Egypt; the three children of Helenus Scott were the first to be vaccinated in India, and thereafter the Doctor vaccinated thousands: the Hindoos, on

account of their veneration for the cow, considered Vaccina a new divinity. Dr de Carro, who had succeeded in importing the virus into Bombay, likewise introduced Jennerian inoculation into Vienna, Lombardy, and Poland. Marcet transmitted the vaccine to Copenhagen, and smallpox disappeared from Denmark and Sweden. Princess Louisa of Prussia was inoculated, and an Inoculation Institute was established in Berlin. Count de Salm offered a reward to the physician who vaccinated the largest number in Moravia and Bohemia. Lord Elgin, ambassador to the Porte, had his infant son vaccinated: the gift which England had received from Turkey, it returned a thousand-fold. The practice entered the Seraglio, and the Grand Seignior, who had suffered much from smallpox, sighed that the discovery had not been made in his early days. Over the Bosphorus, and across sandy deserts, the vaccine was conveyed, traveling along the banks of the Tigris to spread its blessings to Persia. Greek, Armenian and Parsee brought their children to receive the virus. In the Peloponnesus and in Poonah the name of Jenner was lauded to the skies. The history of the discovery was published in Bengalese and in Sanscrit. Ceylon had been ravaged frightfully by smallpox, and in one district and in one month Thomas Cristie vaccinated two thousand natives. Dr Grahl spread it thru Siberia, and no wall could prevent the Chinese from coming in swarms with arms bared for the vaccine. The Spanish government, usually so backward, fitted out an expedition which carried vaccine around the globe. Benjamin Waterhouse introduced vaccination in the United States, and sent a sample of the virus to the brainiest President that ever sat in the White House: Thomas Jefferson with his own hand vaccinated over a hundred of his fellow-citizens.

Then occurred something unique and unparalleled in the annals of medicine. In Upper Canada, the grateful Indians, the Five Nations, the Mohawks, the Onondagas, the Senecas, the Oneidas, the Cayugas, gathered together to pay tribute to Jenner:

‘ Brother! Our Father has delivered to us the book you sent to instruct us how to use the discovery which the Great Spirit made to you, whereby the smallpox, that fatal enemy of our tribes, may be driven from the earth. We have deposited your book in the hands of the man of skill whom our great Father employs to attend us when sick or wounded. We shall not fail to teach our children to speak the name of Jenner; and to thank the Great Spirit for bestowing upon him so much wisdom and so much benevolence. We send with this a belt and string of wampum, in token of our acceptance of your precious gift; and we beseech the Great Spirit to take care of you in this world and in the land of Spirits.’

Crowned potentates, from the King of Spain and the Emperor of France down to the Queen of Etruria and the Hospodar of Moldavia, were desirous of honoring Edward Jenner. A certificate signed by Jenner, declaring that the bearer was abroad merely for his health, had the authority of a passport. The King of England gave him permission to dedicate the second edition of his *Inquiry* to him, but in Jenner’s flattering description of the monarch as ‘ the Father of his People,’ and in his reference to his ‘ paternal care for the dearest interest of humanity,’ we would hardly recognize the brutal George III. The Empress of Russia wrote a personal letter to Jenner and sent him a ring studded with diamonds. She ordered that the first child vaccinated in Russia be named Vaccinoff, and be educated at the expense of the State. Later, Jenner met the Czar himself, and related with some gusto that he was the first person who ever dared contradict the autocrat. During the war between England and France, Jenner petitioned for the release of some British prisoners; Napoleon refused the request, and Josephine mentioned that it was Jenner who wished it. ‘ Ah,’ said Napoleon, ‘ we can refuse nothing to that man.’ Jenner was introduced to so many members of the aristocracy, that he must have grown tired of saying Your Grace and Your Royal Highness, but when a Countess

brought him a hookah, no doubt he promised to smoke it all his life.

The fame which was Jenner's during the latter period of his life, so different from the obscurity of his first fifty years, never upset him. He remained simple and unaffected to the last. He could not learn to love the busy, crowded, gloomy, commercial streets of London, and he was never so happy as when he could steal away to Berkeley by the side of Mrs Jenner. Only one woman in the world existed for Jenner, and she was his wife.

In the days when temples were erected to Jenner, when religious processions marched shouting his name, when men begged for a pattern of his coat that they might wear the same garb on his birthday, Jenner heard that his oldest son was ill, and immediately he left for home. Important letters from London failed to move him. 'In this unfortunate situation,' he wrote, 'I should be unworthy of the name of father were I to stir from my children. Indeed, nothing would make me, not even a royal mandate, unless accompanied by a troop of horse.'

He ended as he began — the best type of the country doctor. On many wintry nights, and over many a stormy road, he urged his horse to the huts of the poor — often without a fee. Contact with royalty had failed to contaminate him. Edward Jenner was a man. When he was molded, the potter used finer stuff than went into the making of Whitelaw Reid, the American Sycophant to the Court of Saint James.

That Jenner should continually have conducted himself with such simplicity and dignity, speaks well for the natural grandeur of his character, for his was not an intellect of the first order. He was a skilled observer, a successful experimentalist, but no thinker. He had not a tithe of the mental reach of the man who first used the term 'agnostic,' and in all phases of rational and abstract philosophy he was a babe. No problems of the origin of our species, or of its ultimate destiny, ever perplexed his mind. He believed an answer to all

such questions could be found in the writings of Moses. Jenner was born in the same year that gave birth to Laplace and Goethe, and when we consider how the Frenchman speculated in the science of the skies, constructing a system of the universe without the hypothesis of God, and when we recall the German's endless intellectual sweep, formulating in a manner even the doctrine of Evolution, Jenner's limitations become apparent.

But in view of Jenner's practical work it would be as unjust to dwell upon his theoretical shortcomings as it would be to emphasize Alfred Russel Wallace's fall from Science to Spiritualism. Men far greater than Jenner have done far less for human happiness than he. Jenner made the most dreaded of maladies the least feared. Mankind is now more afraid of a cold in the head than of smallpox. Even in the poorest sections of our cities we would have to walk long to come across a pitted servant-girl. Measles bends over every cradle; the bacillus that Koch saw in 1881 is as much a menace to-day as it was twenty-five centuries ago, when Hippocrates called consumption the most dangerous disease; every autumn typhoid relentlessly claims its victims; on many doors the Board of Health tacks up the sign 'Scarlet Fever'; and the swift and sudden onslaught of pneumonia carries desolation in its wide trail; but so effectual has been Jenner's discovery that many active physicians of the present generation have never seen a single case of smallpox. The invalid once so common — bloated and puffy with pustules; his skin covered with crusts that fell off only to reveal scars that were permanent; itching, vomiting, delirious; vile to the smell and hideous to the sight; exhausted, feverish, trying to pick the bedclothes with flexed and stiffened fingers; with boils and abscesses in uncomfortable places, hair coming out, and the mouth held half open because of the edema of the buccal mucous membranes; staring apathetically thru a swollen and yellowish mask, with ulcers where eyes should be — this exemplification of agony and wretchedness has become

almost obsolete because Edward Jenner lived and worked.

Modern sanitation has accomplished wonders — a thousand victories of medical science are summed up in that one word — but hygiene cannot account for the practical extermination of the shotty papule. Smallpox never feared soap and water, and was as apt to infect a bathing beauty as Simeon Stylities. Only one agent can keep the smallpox in check, and that is vaccination. And vaccination has done it so well that we have forgotten what smallpox means, and therefore we sit back securely and form anti-vaccination societies. But let the vaccine virus be withheld from our bodies, and before many a moon waxes and wanes, the pock-marked face will greet us on every street-corner.

After the decease of his wife, Jenner retired almost completely from the world. Alone, at sunset, he would climb Barrow Hill and watch the Severn at its highest tide. From the summit he could see the forest of Dean, and afar off glistered the Bristol Channel, where sometimes a ship glided past in the twilight. Here he would linger till the orchards faded from view, and the oaks grew dim and ghostly, and the cliff which rose from the river-side could be seen no more.

His life too was sinking below the hills, soon to be enshrouded in darkness. He died where an intellectual man should die — in his library. The village which gave him birth received his illustrious ashes. When his wornout body was laid at rest, it would not be surprising if some humble woman, whose child he had saved from smallpox, imagined that Edward Jenner had gone to heaven — to vaccinate the angels.

(1781-1826)

LAENNEC AND AUSCULTATION

LAENNEC AND AUSCULTATION

It is quite improbable, I think, that we should be here to-day, or, indeed, have an existence as a society largely devoted to the consideration of diseases of the chest, were it not for the methods of thoracic examination which Avenbrugger and Laennec have given us in their discoveries of percussion and auscultation. Without these two precious methods of investigation we could scarcely have arrived at any degree of precision or certainty in thoracic pathology.

—EDWARD O. OTIS.

LEOPOLD AVENBRUGGER was no fool; he had read history, and he knew the usual fate of the innovator: the contumelious stone during life, and a monument after death. Therefore, when sending his *Inventum Novum* out into the world, he wrote this little preface:

‘ I present to the reader a new sign for the detection of diseases of the chest, which I have discovered. It consists in the percussion of the human thorax and the determination of the internal condition of this cavity by the varying resonance of the sounds thus produced. My discoveries in this subject are not committed to paper because of an itch for writing, nor an inordinate desire for theorizing. Seven years of observation have put the subject in order and have clarified it for myself and now I feel that it should be published.

‘ I foresee very well that I shall encounter no little opposition to my views and I put my invention before the public with that anticipation. I realize, however, that envy and blame, and even hatred and calumny have never failed to come to men who have illuminated art or science by discoveries or have added to their perfection. I expect to have to submit to this danger myself, but I think that no one will be able to call any of my observations to account. I have written only what I have myself learned by personal observation over and over again, and what my senses have taught me during long hours of toil. I have never per-

mitted myself to add or subtract anything from my observations because of the seductions of preconceived theory.

‘I would not wish, however, that anyone should think that this method of diagnosis, which I suggest, has been developed to its utmost perfection. I confess with all candor that there are defects which conscientious observation will, I hope, amend with time. It is possible that there are even other important truths for the recognition of disease still hidden from this method of diagnosis. Some of these may prove of great usefulness for the differentiation, prognosis and cure of diseases of the chest.

‘This was the reason why in my personal experience, after I had succeeded in finding the signs in the chest and proceeded further to the investigation of their causes so far as my own observation could help me, I have always afterward had recourse to the commentaries of the most illustrious Baron Van Swieten, since I have considered that whatever can be desired by an observant man is sure to be found in his work. I have thus been able to spare you a long disquisition. I have found in his work a sure basis of knowledge on which my slight superstructure may be raised up to view.

‘I do not doubt, however, that I have accomplished a work which will earn the gratitude of all true devotees of the art of medicine, since I have succeeded in making clear certain things which shed not a little light on our knowledge of the obscure diseases of the chest, a subject hitherto very imperfectly understood.

‘I have omitted many things that seem doubtful because they are as yet not sufficiently elaborated. I shall endeavor, however, faithfully to devote myself to the further development of these points. Finally, it has not been my effort to write in any elegant diction. I have chosen a style in which I may be thoroly understood.’

It will be noticed that in this foreword Avenbrugger refers to his teacher, and thruout the monograph the name of Van Swieten is mentioned with the greatest respect. Van Swieten certainly had merits as a medical man: when he was called over from Holland, the Austrian throne had no heir; but Van Swieten drew the husband aside, gave him some private

instruction, with the result that Maria Theresa became pregnant sixteen times. Van Swieten spent most of his life writing eight huge volumes of commentaries on the aphorisms of his master Boerhaave, and tho some say that the commentaries are more valuable than the aphorisms, neither one nor the other is now read. Van Swieten wrote much on the diseases of the chest, but he did not mention percussion. The eminent doctor saw no use in tapping the thorax. He did not know that his pupil's finger had ushered in the era of modern diagnosis.

Gerhard Van Swieten's successor, the unpleasant Anton De Haen, left eighteen volumes behind him—including a treatise in defense of witchcraft. The historical student who digs among these paper ruins will find the author complaining that it is almost impossible to recognize thoracic diseases until it is too late to help the patient. The obstinate man did not see that in response to the physician's rapping, the door of thoracic knowledge opened.

But Avenbrugger had anticipated neglect, and he was too well-poised to permit himself to be embittered or become exasperated. He devoted himself to practice, made money, went to the opera in winter, cultivated a garden in summer, kissed his wife every day, and lived to celebrate his golden wedding.

While Avenbrugger was growing old in Vienna, a child was growing up in Brittany. He was sickly-born, the offspring of a tuberculous mother. One day, when the child was six years old, the neighbors came in and looked at him sympathetically, and the woman patted him kindly on the shoulders, for his mother was dead. His father was a lawyer, but the versatile advocate wrote poetry like Desforges-Mailard and was too busy in other respects to be bothered by a frail orphan. He brought the boy to his grand-uncle, an Abbé at Elliant.

The uncle saw that the child was obedient, and decided there would be another priest in the family. From him René Laennec received considerable misinformation which he never for-

got. The child was well-treated, and it seemed as if his existence would be eventless — he would quietly pass from his uncle's district to a parish of his own. For what can happen in Brittany? It is the land of the past, the province of the dead. In La Bretagne only the cock and the artist welcome the rising sun. To study a Breton peasant is like turning over a well-preserved half-animated fossil. His skull is thick enough to resist the advances of French civilization. He will not even speak French, but still whines out his barbarous *patois*, for he is convinced it is the language Adam and Eve spoke in paradise.

The Breton folk are as unchangeable as the Druidical dolmens and menhirs which litter their country. They are victims of the *idée fixe*; in politics and religion a new thought will never filter thru Brittany. In a thousand years, or in five thousand years, when the present theology disappears with its predecessors, the last Christian will be a Breton peasant.

The Bretons have never had any interest in the rest of the world, but outsiders have printed and painted the name of Brittany with praise. This is because Brittany is visited chiefly by clergymen who need a rest, and by artists in search of color. The former eulogize Brittany on account of the docility and piety of the inhabitants, and the artists are enchanted because the men wear long hair, broad-brimmed hats, blue blouses, large belts and baggy breeches of sail cloth, and because the women dress in white caps with wide lappets, and, instead of corsets, are arrayed in pretty spencers laced up in front of the waist which open above to allow for the swell of the bosom. When the Bretons begin to purchase their costume from Paris, we will hear no more of quaint and picturesque Brittany.

When René Laennec was nine years old, strange deeds were done: churchmen, including his uncle, were banished. Excited Frenchmen ran along the roadways, crying *Liberté, Egalité, Fraternité*, and pulling down the crucifixes: they had much work to do, for in Brittany wherever two roads meet,

there a crucifix is erected. What was happening? Was the world coming to an end? Ah, the world was being saved. It was the great and glorious French Revolution.

From the Reign of Terror issued an ocean of blood, but that scarlet stream watered the tree of liberty; in eternal letters it wrote the Rights of Man; it cast the oligarchs and the theocrats down; it exalted the disinherited of ages; it overthrew a royal carnival of crime hideous beyond belief; everywhere it uttered the glad tidings, *Nous avons changé tout cela*.

As might be expected the antiquated Bretons fought on the side of the old monarchy against the new republic. It did not matter to them that there was a law in France which gave the nobles permission to shoot at workmen on roofs, merely for the sport of seeing them tumble off. Probably the fact that an aristocrat was not expected to kill more than two toilers during a day's merriment — otherwise, labor would grow scarce,—made the honest Breton heart pulsate with devotion towards his merciful superiors. As an experiment it might be interesting to attempt to educate the cattle of Brittany — excluding the dullest beast of the field, *la vraie Bretagne bretonnante*.

After the Abbé's proscription, the boy was sent home to his father. ' *Mon Dieu,*' exclaimed that gentleman, and suddenly remembered that René had another uncle, a most honorable and distinguished man, Dr Laennec of the University of Nantes.

For ten years René remained under his guardianship, and here it was settled that he would follow in the footsteps of his medical relative. Then came the desire which in every period stirs all ambitious hearts that beat in provinces: to study in the capital. In the year 1800, at the age of nineteen, Laennec came to Paris.

Within the mesh of Parisian gaiety many a youthful student from the provinces has been lost, but René Laennec had come for the college curriculum, and the world of merriment had no meaning for him.

Two years after his arrival in the French metropolis, Laennec attracted attention by a series of excellent articles which he contributed to the *Journal of Medicine*, a periodical which he eventually owned, but which at that time was edited by Corvisart, Leroux and Boyer.

Laennec was a favorite pupil of Corvisart, who had a mighty name in those days, for he was physician to the demigod who emerged from the wreck of the French Revolution. Napoleon had a cold in his chest, and was suspicious of the attendants who felt his pulse and looked at his tongue. He was told there was a doctor who diagnosed troubles in the chest by examining that part of the body. 'Send him to me,' said Napoleon. Corvisart came, and tapped the imperial thorax with his finger-tips. Thereupon Napoleon decided that Corvisart should have the honor of looking after his majesty's health. They grew so intimate that after the birth of the King of Rome Corvisart was audacious enough to lecture the world's chief phenomenon: 'Sire, this prince must crown all your wishes! Recall your career: in less than ten years a simple officer of artillery, then captain, general of brigade, general-in-chief, first consul, emperor, spouse of an archduchess of Austria, father of a prince. Having reached so dizzy a height of fortune, rarely attained by any mortal, I beg of your majesty to stop! Fortune may turn; you may yet fall.'

'You speak like a peasant,' answered Napoleon.

But we must not forget to ask: Where did Corvisart learn percussion? De Haen's successor was Maxmilian Stoll, who had the misfortune to marry the meanest woman on earth, but who was the most enlightened member of the Old Vienna School. Stoll praised Avenbrugger's work, and a pupil of Stoll, named Eyerel, wrote a treatise on percussion which came to Corvisart's notice. Later Corvisart came across Avenbrugger's *Inventum Novum*, and decided to translate it. 'I know very well,' wrote the generous Frenchman, 'how little reputation is allotted to translators and commentators, and



LAENNEC

I might easily have elevated myself to the rank of an author, if I had elaborated anew the doctrine of Avenbrugger and published an independent work on percussion. In this way, however, I should have sacrificed the name of Avenbrugger to my own vanity, a thing which I am unwilling to do. It is he, and the beautiful invention which of right belongs to him, that I desire to recall to life.'

Before Corvisart, percussion was the possession of a handful; after Corvisart, percussion became common property. The torch which Avenbrugger kindled, Corvisart re-lit for all futurity. So we see that tho the torch of truth often flickers low, yet its immortal light is never wholly quenched. Floods of misunderstanding may roll over it, the weight of authority may threaten it, but thruout the long night it glimmers faithfully, waiting for the truth-seeker who will raise it aloft and bring morning to the intellectual world.

Besides Corvisart, Laennec's name is associated with that of Broussais, but in a very different manner. With Corvisart he came into loving contact; with Broussais he was in angry conflict. Laennec had no use for Broussais, and Broussais saw no good in Laennec. Broussais was a master of sarcasm, and Laennec was not backward in bandying scorn. No doubt Broussais was more talented in this respect, but then he had numerous and various hatreds, while Laennec could concentrate. When he spoke of Broussaisism his voice became acid, and his eyes shot sparks of indignation thru his tortoiseshell-rimmed spectacles. What must have added special piquancy to the warfare between Broussais and Laennec was the circumstance that both were Bretons, and of all people in the world none are so chauvinistic as the folks that hail from Brittany.

Broussais was the medical theorist of the hour, and elaborated a complex system of 'physiological medicine,' but Corvisart and Laennec accepted only the Hippocratic watchword, Observation. Neither of the contestants was fair to the other, but it must be said that most of Broussais's theories are

now as obsolete as his hirudinomania, which was carried to such an extent that within a calendar year it became necessary to import forty-two million leeches into France. At one time there was hardly a French belly which had not given nourishment to these blood-suckers.

His theory of irritation as the cause of disease had great vogue in its time, and Oliver Wendell Holmes who heard Broussais in his latter days, told his Harvard students, 'The way in which that knotty-featured, savage old man would bring out the word irritation — with rattling and rolling reduplication of the resonant letter *r* — might have taught a lesson in articulation to Salvini.'

In 1812, eight years after his graduation, Laennec was appointed physician to the Beaujon Hospital. Gifted and conscientious, willing to work to the point of exhaustion, Laennec became one of the most renowned pathologic anatomists of the nineteenth century. He was particularly interested in the diseases of the chest, and of course employed percussion as he learnt it from Corvisart, but no one yet knew that Laennec was to be Avenbrugger's spiritual heir.

The malady which Laennec studied above all others was tuberculosis, the insidious foe which killed the woman who gave him life. Day and night his thin hands grappled with the ancient enemy of the human race. Immemorial indeed, for who shall say in what distant epoch this subtle thief first gained access to the lungs of man? Who knows in what dark and nebulous time a primeval mother first listened in an agony of helplessness to the hacking cough of her infant? We are aghast at the mortality-tables of a sanguinary war, but on the white bed of consumption fall more victims than on the red field of battle.

In 1816 Laennec was transferred to the Necker Hospital. During this year a woman who was suffering from heart trouble consulted him. Laennec questioned her, but was puzzled how to proceed with the examination. There was no use in thumping her thorax, for the patient was too stout;

neither could he put his ear directly upon her breast, for she was still young. We may argue that physicians have privileges, but Laennec himself claims that immediate auscultation was inadmissible. In his dilemma he happened to recollect a fact in physics. Acting on the idea, he rolled a quire of paper into a kind of cylinder and applied one end of it to the region of the patient's heart and the other to his own ear. This was the first stethoscope. Then René Laennec heard the language of pathology. A diseased heart appealed to him for aid. Injuries that for centuries had been inaudible, now found a voice. A sick organ murmured its tale of woe into the ear of a great and sympathetic physician. Auscultation, the crowning glory of physical diagnosis, came into existence.

In the guesses of philosophers like Democritus, who had nothing except the deductive method, we find foreshadowed nearly every principle of modern science, but the ancients knew practically nothing of auscultation. Even Hippocrates refers to the subject but once, and his observation is erroneous. He says in *De Morbis*, 'You shall know by this that the chest contains water and not pus, if in applying the ear during a certain time on the side, you perceive a noise like that of boiling vinegar.' Aretæus too seems to have known and practiced a sort of auscultation, but otherwise medical antiquity had no ear.

In the seventeenth century the Englishman Robert Hooke stumbled upon the truth, but altho this versatile genius sowed seeds in twenty different fields, he never remained to harvest the crop. There is still enough unworked soil in Hooke to support discoveries for the next three centuries. 'I have been able,' wrote Hooke, 'to hear very plainly the beating of a man's heart; and it is common to hear the motion of the wind to and fro in the guts and other small vessels; the stopping in the lungs is easily discovered by the wheezing, the stopping of the head by the humming and whistling noises, the slipping to and fro of the joints, in many cases by crackling and the like.

As to the working or motion of the parts one amongst another, methinks I could receive encouragement from hearing the hissing noise made by a corrosive menstruum in its operation, the noise of fire in dissolving.'

After his invention Laennec toiled like a fanatic. An undersized body did the work of twenty men. He improved his stethoscope, and with his instrument discovered many secrets in the wondrous box that holds the heart and lungs. He began also to write out his observations. As the industrious days went on there gathered on his desk a pile of manuscript which looked as if it weighed more than the author. At last he was ready to write the preface, which is somewhat reminiscent of Avenbrugger's foreword. 'I may say,' wrote Laennec, 'that no one who has made himself expert with this method will have occasion to say with Baglivi, Oh, how difficult it is to diagnose disease of the lungs! But our generation is not inquisitive as to what is being accomplished by its sons. Claims of new discoveries made by contemporaries are likely for the most part to be met by smiles and mocking remarks. It is always easier to condemn than to test by actual experience. It suffices for me if I can only feel sure that this method will commend itself to a few worthy and learned men who will make it of use to many patients. I shall consider it ample, yea, more than sufficient reward for my labor, if it should prove the means by which a single human being is snatched from untimely death.'

It was now ready for type. The manuscripts became proof-sheets, the proof-sheets became printed pages, and the printed pages became a book. Laennec's *Treatise on Mediate Auscultation and the Use of the Stethoscope* is universally recognized as an imperishable medical classic. But the author took no joy in his finished work. His life, his strength, his spirit, had gone into the making of his book. The book was vital with robust and fresh-blown power; the writer was weary, broken up and undone. Laennec lost interest in everything. Food was set before him, but he could not eat. A bed was

prepared for him, but he could not sleep. He breathed with difficulty, he suffered from muscular debility, the slightest exertion being followed by the greatest prostration, and often he fainted. A deep melancholy sat upon him: he was a picture of an overworked neurasthenic.

Laennec had just enough sanity in balance to know that he must escape from Paris and return to Brittany. So he left the crowded hospital-wards, and after a terrible journey, stood once more in his native town of Quimper. The sea-breeze came from the shores of the Bay of Douarnenez, and the hills and the forests were green. Laennec smelled the air fragrant with fresh butter. He saw the long-haired peasants stand knee-deep in fields of buckwheat; he heard the girls singing as they drove the cows home from pasture, and he felt that here he might recover. Nature was his physician, and she prescribed him daily doses of the earth and the sea and the sky. Abstaining from mental effort, he spent his time in the open air, riding horseback, angling in the stream, hunting the woods for foxes and partridges. The breath of a new life entered that wasted frame; color crept into those pallorless cheeks. 'Anne, cook this pair of snipes,' he said, as he put down his bag and rifle, 'I'm as hungry as a bear.' The household was in delight — René was getting well.

For two years Laennec lingered at Quimper. Quimper is the quintessence of Brittany — everything characteristic of the province has retreated and crystallized there. Quimper has not wound her clock for centuries, and the sands in her hour-glass do not run. It is the same time now that it was when the Druid priests chanted their heathen hymns under the oaks, and if they returned they would see the monuments they erected still standing — but surmounted by a cross. In Quimper, on the cradle and the grave alike, falls the dust of a distant past.

Laennec loved Quimper — who ever heard of a Breton that did not relish the very dung-heaps of Brittany? Breton sailors have been known to pine so passionately for their na-

tive land, that they died heart-broken upon the voyage. Laennec was sympathetic towards the peasantry, and was ever ready to use his medical skill in their behalf — and forget the fee. As a member of the Ultramontane Church, Laennec was a determined enemy of free institutions, autocracy was his ideal, democracy was a red spectre to him, but tho Laennec would not trust the common people to govern themselves, he was fond of them, for a man's theories do not fundamentally affect his character.

But with the return of health came the conviction that a physician's place is at the clinics and not on the mossy banks where at twilight the poet reclines. He thought of the endless invalids at Paris who were victims of improper diagnosis — he should be there with his stethoscope. It was time to exchange the gossamer ferns of the fields for the delicate gauze of the wards.

Laennec was again at Paris. During his absence his pupils had carried on his work, his book had gained him a reputation, and honors awaited him. Not only was he made Professor of Medicine in the College of France, not only did he receive the chair of Clinical Medicine at the Hospital La Charité, but he had the felicity to be appointed physician to the Duchess of Berri. We need not be surprised at his gratification, for the royalty-superstition, barbarous tho it be, seems inbred in the bones of man. Even so liberal a thinker as Huxley felt flattered when he was granted an interview with a fat and commonplace widow, who thru no merit of her own happened to be a queen. Goethe was a life-long sycophant at the court of Saxe-Weimar, and when the duke rode off to join the armies of the Allies who endeavored to replace Louis XVI on his bloody throne, the author of *Faust* — let the Muses blush — followed the duke.

But Laennec was more interested in the hospital than in the noblesse; essentially he was a physician, not a courtier. Again he forgot the limitations of flesh; his earnest spirit would not let him rest. Bayle had demonstrated that when

tubercles are present in the lungs, the patient has tuberculosis — but the doctor could not recognize the condition until the hectic fever set in and the pus was spat up. By auscultation, however, tuberculosis could be diagnosed in an early stage, and thus the labors of Laennec began to reduce the death-rate of the most prevalent of diseases. The impetus which Laennec gave to the study of thoracic troubles, was felt thruout the medical world. In this instance the triumvirate of the Irish School of Medicine especially distinguished themselves: Graves, by his fresh-air propaganda for tuberculosis; Stokes, by the book on the stethoscope that he wrote in his twenty-first year; and Corrigan, by his work on *Permanent Patency of the Aortic Valves*. To the Hospital La Charité came students from all nations to hear the lectures of the diminutive, narrow-chested man, who first raised a hopeful voice against the Great White Plague.

After the elapse of a few years it was necessary to prepare a second edition of his *Treatise*. 'Second edition' to the majority of authors means the correction of a few errors, the addition of a few notes, the insertion of the legend on the title-page, Revised and Greatly Enlarged, and an expression of gratitude in the preface that the second edition was needed. But to so conscientious an individual as Laennec, a second edition meant the re-writing of the entire book. To write a book with the sweat of your brain and your heart's blood is a serious thing; nature usually throws nervous prostration into the bargain. For a quarter of a century Lagrange worked on his *Mécanique Analytique*, but when the volume was finally printed, the author let it lay for over two years on his desk unopened. He was too tired. The efforts that Laennec expended upon the second issue of his magnum opus, together with the Herculean labors which this pigmy performed in the clinics, again wrecked his health on the altar of overwork. In this state his only remedy was Quimper. Once more he returned to his native town, and life and death struggled in his sunken chest.

A party of travelers presented themselves at a house in Quimper, and knocked for admission.

‘What do you want?’ asked the man who came to the door.

‘We are weary of wandering; let us rest at your hearth.’

‘Pass on; the roads are full of vagabonds; who knows who you may be?’

‘Be hospitable, brother; the sky threatens; a storm is coming.’

‘If you hasten you will reach the next inn before the clouds burst.’

‘Listen,’ says the spokesman of the pretended travelers, ‘I deceived you when I asked for shelter. I come for another purpose. My young master desires the girl of this house. There was never a youth like him. He can plow as much in one day as three hired laborers; alone he can replace an overturned cart; he has wrestled with all the able-bodied men of the village, and has laid many champions on their backs; in his hand a stick is more powerful than a sword in the hand of a soldier.’

‘And this maiden,’ replies the other, ‘think you there are many as good as she? She is light and supple as the blossom-covered branches of the broom. She is a timid virgin, and when the dance begins, she holds in one hand the hand of her mother, and in the other that of a female friend. But she is not here; she has long left her father’s house.’

‘You deceive me; the yew-tree is made for the church-yard, the rose for the garden, and young girls to grace the home of a husband. Do not throw us into despair! Lead hither by the hand her whom we desire, and we will place her at the wedding-feast near her bridegroom.’

‘It seems we must yield to you, friend. I will fetch her,’ and going into the room he comes back with an old woman, and asks, ‘Is this then the rose you are seeking?’

‘From the venerable appearance of this woman,’ replies the other, ‘I judge that she has well-fulfilled her task in this world, and that she has conferred happiness on him who has

loved her. But she has ended that which the other must now begin. She is not the woman I seek.'

The host returns again to the house, and leads forth a young married woman. 'Here,' he says, 'is a young girl, beautiful as a star. Her cheeks are like roses; and her eyes are of crystal. One glance from them can render a heart sick for ever! This must be the fair one whom you want.'

'Certainly this soft cheek and youthful freshness look like those of a maiden. But that finger, bearing the marks of rubbing — has it not often been rubbed with pap for an infant to suck?'

'Nothing escapes your notice! Tell me, is this she whom you want?' and he brings out a child.

'That is exactly what she, whom I seek, was some years ago. Some day this pretty child will make a husband happy. But she must remain yet a long while on the espalier. The one whom I want waits for the gardener's basket to carry her to the table of the nuptial feast.'

'Friend, it is enough,' says the bride's spokesman, 'You deserve her whom you seek.'

Together the two families enter the house. The bride and bridegroom clasp hands, all kneel in prayer, then repair to church, and return for the feast. At the head of the principal table, opposite each other, sit the happy couple, and between them is placed a gigantic dish of butter. Hundreds of peasants are present; they eat and drink and dance; they swallow a flock of ducks and chew a herd of cows — they eat and drink and puke. They gulp down barrels of liquor till we marvel at the capacity of the human alimentary canal. They eat and drink and roll under the tables, every atom drunk.

At midnight, in the presence of the company, the bride is undressed and put into the oaken bed; the bridegroom jumps in beside her, walnuts and wine are passed to them, and the celebration continues. Gradually those guests who are not asleep begin to take their departure, and Quimper grows as quiet as usual — so quiet that in the silent night we can hear

a hacking cough. Laennec is perishing of tuberculosis. He passes away holding in his hand a cross. He dies modestly, forgetting that the stethoscope has done more for mankind than the crucifix.

Laennec's name remained the greatest in the history of tuberculosis until the epochal evening, two generations later, when Robert Koch read his paper, *The Etiology of Tuberculosis*, announcing that a short rod-shaped bacterium was the sole and only causative agent of the universal scourge. Suffering mankind now awaits him who will discover a remedy to destroy Dr Koch's bacillus. In high expectation Koch himself proclaimed that he had found a specific; but tuberculin is a stain — the only one — on the Hanoverian's bright escutcheon. The Jenner of tuberculosis has not yet arisen; when he comes, when he brings to the medical market the blessed drug that will materially help to transform consumptives into normal human beings, the historical student will join in the general rejoicing, but he will not forget how much the world owes to the previous labors of René Laennec.

(1811-1870)

SIMPSON AND CHLOROFORM

SIMPSON AND CHLOROFORM

I also attended on two occasions the operating theater in the hospital at Edinburgh, and saw two very bad operations, one on a child, but I rushed away before they were completed. Nor did I ever attend again, for hardly any inducement would have been strong enough to make me do so; this being long before the blessed days of chloroform. The two cases fairly haunted me for many a long year.

—CHARLES DARWIN.

Behold me waiting—waiting for the knife;
A little while, and at a leap I storm
The thick, sweet mystery of chloroform,
The drunken dark, the little death-in-life.

—WILLIAM ERNEST HENLEY.

A GOSSAMER mist glided out of cloudland, floating quietly and falling gently on the crags of the shore. The delicate water-dust struck the points, settled on the peaks, and broke into a vaporous fog. The opaque haze bedimmed the air, but the careful pilot in the sea below steered his passengers along the southern coast of the Firth of Forth. To the castled county of hilly Linlithgow were the tourists bound. Toward the green knolls that divide the lake in twain were they traveling. They were on their way to the remains of the finest ruin in Scotland — the Linlithgow Palace.

They walked around the fountain whose waters had once bubbled for the delight of royalty — now as dry as a rill that has ceased to be fed by rain. They looked at the chambers in which were born James II, James V, and Mary Stuart. They stood on the very spot where King Fieryface, from the window above, had hurled the lifeless body of the Earl of Douglas. They climbed the spiral staircase till they came to the bower where Queen Margaret used to wait for James IV,— who never returned from Flodden Field.

They lifted their eyes and saw the famous battlefield of

Bannockburn. Here Robert Bruce defeated the English army, restored Scottish independence, and gave Robert Burns a chance to write what Carlyle called the mightiest war-ode in the world — *Scots wha hae wi' Wallace bled*.

Surely the scene is romantic enough, and many would fain dwell longer in the enchanted vicinity and imagine a chieftain fighting in every cave and cliff, while the minstrels chanted ballads o' the border. Some would sentimentalize on the kings and queens whose blue-blooded bones are moldering like the walls of their favorite castle.

But no pen of ours can scratch a line of praise for monarch or warrior. Besides, lest it be imagined that every goose in Linlithgow is a swan, and all the lads and lassies be of blood-royal, we hasten to add that here lived, with his wife and family, a simple baker named Simpson.

Seven children tarried in the old home-nest, and grew lusty on their father's bread. They loved each other heartily, and made merry under the paternal roof. Yet one day they were warned to be very quiet. The baker himself walked on tip-toe, and spoke in whispers. A nurse moved noiselessly thru the rooms.

Plaintive moans were heard. Such sounds were not strange to Simpson, and still they frightened him. He knew the woman he loved was fighting the brave battle and facing the great mystery. The cries increased — the pangs of child-birth are severe. Scream followed scream — the mother labored in the agony of agonies. A heartbreaking wail which the closed door could illy bar pierced every corner of the house and pierced likewise the soul of the father. Again that shriek escaped her, and the middle of the marrow of his bones seemed to shake. He rose in his nervousness, and shuddered with an uncommon fear.

He heard gasps. Was she struggling? Was she trying to breathe? Was she dying? Ah, what a shrill, keen outcry! How long must it last? Will it never end? Is there nothing to stop such suffering? Can the physician offer no remedy to

assuage such violent anguish? No, Simpson, no. The doctor who now stands in your rooms is empty-handed, but listen — the times may change.

Open the door and peep in the chamber. On the bed lies your exhausted wife. The tears are in her eyes, and her face is pale with pain. But see what she holds in the crook of her elbow — a babe.

Father, you should tell the highlanders to play a gladder pibroch than their bagpipes yet have known; the times will change, the times will change. Tell them to pipe it over the tallest hills and across the faraway seas; the times will change, the times will change. Shout to them to blow stoutly on their sturdy reeds until the new tune brings a new joy upon the earth; the times will change, the times will change. A babe who is born of woman will bring unto woman a boon!

It is we who can say these things as we look back in perspective; Simpson's thoughts were more commonplace.

The Simpson family held a serious consultation — what was to be done with their youngest boy? It would be fine to send him to the University, but this required more bank-notes than Simpson received for his oaten cakes and barley bannocks. The sacks of flour were ready, the stone ovens were heated hot, and the yeast was added to the dough till the mixture rose like a living thing — but the cold money did not rise.

They discussed the matter again, and at night the father and mother whispered low and lovingly — so the children could not hear. The University idea became the dream and desire of their hearts — James must go.

Even if poor, there is little a united family cannot do. In union there is a strength that conquers adversity and puts a quietus on poverty. You cannot break the bundle of sticks when they are tied together. When little Jamie, 'the rosy bairn wi' laughin' mou' and dimpled cheeks,' was only nine years, his mother died — but the idea remained. All the Simpsons agreed to save and struggle and sacrifice for the sake

of the little brother, and thus it was that at the age of fourteen James Young Simpson became a student in the University of Edinburgh.

For the first two years he attended the arts classes, and then began his medical studies. The boyhood history of many men of eminence reveals the fact that they flunked in their quizzes at school, and received degrees only from the University of Life. But Simpson, being the son of poor parents, could not afford to indulge in this luxury. He seized the college curricula with both hands, and held on. He studied diligently, passed the required examinations, became a Doctor of Medicine at the age of twenty-one, and presented a thesis, *On Death from Inflammation*, which so impressed the Professor of Pathology that the recent graduate was offered and accepted an assistantship.

In this respect Simpson differed materially from a tall young fellow who entered the Edinburgh University the same year that he did. The aforesaid tall young fellow was the son and grandson of a physician, and he likewise commenced the pursuit of medicine. But he found the lectures so intolerably dull that it was impossible for him to prepare his lessons. Perhaps the cheerful fact that his father was well-to-do acted as an additional stimulant to his idleness. He soon deserted medicine in disgust, and solemnly vowed never to look within the covers of a scientific book. Yet the day came when the Royal Medical Society of Edinburgh made him an honorary member, and the strict Universities of Breslau, Bonn and Leyden honored themselves by giving him an honorary M.D. This drone did not eat in the hive of inactivity till he was stung to death by the workers. The time came when he gathered more honey than all the others. He was Charles Darwin.

Who invented the telegraph? Morse, you say, but Morse built on Henry, who built on Steinheil, who built on Weber and Gaus, who built on Faraday, who built on Davy, who built on Nicholson and Carlisle, who built on Galvani and



SIMPSON

Volta, who built on Don Silva and Cavallo, who built on Lomond, who built on Lesage, who built on Stephen Gray, who built on others, back and still further back.

Who first scanned the heavens with a telescope? Galileo, you cry, but before the great Italian fitted a convex lens at one end of a leaden tube and a concave at the other, he had heard of an instrument which annihilates distance and magnifies objects in a wondrous way. Some say — and with good reason — that the telescope was invented by three clever Dutchmen, Jansen, Metius and Lippershey; others claim that long before these Dutchmen saw the light, Roger Bacon knew all about optic glasses and could combine them to form a telescope. And, reader, haven't you read that five centuries B. C. the Laughing Philosopher declared the Milky Way to be composed of vast multitudes of stars? Could he have seen this without some sort of a telescope? If so, then the eye of Democritus was as unusual as his brain.

Whom shall we call the Father of Anesthetics? Here we must pause, for ever since mortal felt a twitch of physical pain, he wished to drink of Lethe. Indian hemp or hasheesh seems to have been the first anesthetic, for it is believed that this was the plant with which the Egyptians numbed their patients before surgical operations; it is further believed that this was the sorrow-easing drug which Helen gave to Ulysses in the *Odyssey*. It is possible, however, that in both of these cases opium was the medium, or perhaps a mixture of the hemp and the juice of the poppy.

More than six thousand years ago the Babylonians used mandragora, and there are Biblical and Talmudic references to soporifics.

Of course the keen Greeks and Romans knew several remedies to assuage pain and paralyze sensation. Allusions to them are found scattered thru the works of Dioscorides, Pliny, Celsus, Galen, Paulus Ægineta and others. 'If anyone,' wrote Apelius, 'is to have a limb mutilated, burnt, or sawn, he may drink half an ounce of mandragora with wine; and

while he sleeps the member may be cut off without any pain or sense.'

In the third century the Chinese doctor Hao-Tho anesthetized his patients with ma-yo, which was probably the hemp plant.

During the Middle Ages the leading apostles of anesthesia seem to have been Hugh of Lucca, the inventor of the Sleeping Sponge, and Guy de Chauliac, one of the chief figures in the history of medieval medicine. In his *Chirurgia Magna* is this passage: 'Some prescribe medicaments which send the patient to sleep, so that the incision may not be felt, such as opium, the juice of the morel, hyoscyamus, mandrake, ivy, hemlock, lettuce. A new sponge is soaked by them in these juices and left to dry in the sun; and when they have need of it they put this sponge into warm water and then hold it under the nostrils of the patient until he goes to sleep. Then they perform the operation.'

References to anesthesia are not infrequent in the literature of the times. In Boccaccio's *Decameron* a surgeon of Salerno discourses of his soporific. The Shakespearean student will recall the master's mention of mandrake: Iago tells Othello of it, and Cleopatra calls for mandragora when Anthony is away, to sleep out the great gap of time. Another dramatist of this period, Thomas Middleton, in his *Women Beware Women*, wrote:

I'll imitate the pities of old surgeons
To this lost limb, who, ere they show their art,
Cast one asleep, then cut the diseased part.

Still another Elizabethan poet — the youth who flung away his genius in a brothel as carelessly as a fisherboy casts a pebble in the sea — makes Barabas in the *Jew of Malta* say:

I drank of poppy and cold mandrake juice,
And being asleep, belike they thought me dead,
And threw me o'er the walls.

In truth at this period anesthetics appeared to more advantage in poetry than in practice. The outcome was always uncertain, and in the seventeenth century anesthesia was almost wholly forgotten or abandoned.

But then followed the Chemical Century, when numerous gases were discovered, and experimenters began to inhale all sorts of vapors, and Humphry Davy learnt the anesthetic virtues of nitrous oxide which had recently been discovered by Priestley, and Michael Faraday found sulphuric ether to be possessed of similar properties. In his *Researches Chemical and Philosophical*, published in 1800, Davy wrote: 'As nitrous oxide in its extensive operation seems capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place.'

It is strange that a statement so richly suggestive should have been barren of results. But more than another generation had to pass before the subject was further investigated, and it was in another country that anesthesia first became an effective blessing. Practically speaking, anesthesia is an American discovery. In the fourth decade of the nineteenth century, teeth were painlessly extracted and amputations performed under the influence of nitrous oxide and ether. It is an epoch of glory and shame, for on the trail of this revelation — unquestionably one of the grandest in all medical history — strode tragedy, suicide, scandal, greed and law-suits. The discovery was made for the benefit of humanity, but human selfishness is written large all over it. Priority and patent-rights — these were the questions that were angrily argued between the suspicious disputants. Even yet the dust of hatred has not settled, and looking thru the haze of misunderstanding it is still impossible to sum up the merits of the case; tho we know alas! that out of the four principal claimants, one died in obscurity, the second died broken-hearted, the third died in a lunatic-asylum, and the fourth died by his own hand in jail.

But besides Long, Morton, Jackson, and Wells, at least a dozen other Americans were among the pioneers of anesthesia: Colton, Riggs, Clarke, Marcy, Warren, Hayward, Pope, Bigelow, Holmes, Godman, Wood and Bache.

Yet tho we cannot decide upon whom to place the badge of Founder of Modern Anesthesia, one event in the history of relieving pain is certain: the first physician to openly use an anesthetic in a case of childbirth was James Young Simpson. In this he had no precedent: he was inspired by the example of no one, unless perchance it were the murdered spirit of the Lady Eufame Macalyene, who in this very city of Edinburgh was burnt at the stake by the ecclesiastics for attempting to deaden the pangs of labor by artificial means.

The first drug which Simpson used in his obstetric case — January 19, 1847, a date worth remembering — was ether. Not being quite satisfied with its efficiency, he searched for an anesthetic of more energetic action. With his talented assistants, Drs Keith and Matthews Duncan, he tested the properties of the vapor of iodoform, acetone, benzine, chloride of hydrocarbon, nitrate of oxide of ethyl, and various oils and gases. None of these caused him to cry, 'Eureka!'

On the evening of November 4, 1847, the experimenters inhaled several substances without any marked effect. Ether still remained the unrivalled anesthetic. At this moment Simpson happened to remember that a Liverpool chemist named Waldie had spoken to him about a certain heavy colorless liquid. Simpson looked for the bottle, but could not find it. Probably when he was on the point of remarking that it wasn't of much importance anyhow, the amber-colored bottle was pulled out from the bottom of a heap of waste paper. Simpson scrutinized it again, and shook his head dubiously. It seemed to him too ponderous to be of much value.

But he took out the stopper, poured the contents in the tumblers, and the three inhalers eagerly shoved their noses to the brim. In a moment they rose — happier than when they had sat down. Dr Keith's eyes grew bright and he laughed

heartily. Dr Duncan waltzed around the room, and Dr Simpson, altho he was usually the dignified Professor of Medicine and Midwifery at the University of Edinburgh, now wiggled his toes and would have stood on his learned head for a doughnut. Some ladies came into the room, and the gentlemen were remarkably amiable. They were more polite than Chesterfield, and the silvery stream of continual conversation which unceasingly flowed from their gifted tongues would have worried the mouth of Richard Brinsley Sheridan. The delighted ladies had never before met such pleasant companions. They did not know that these gay Lotharios were drunk — on chloroform! General Wolfe was killed at the moment of victory, and, unfortunately, in the midst of their newly-acquired popularity with admiring femininity, the secondary effects of the chloroform vapors became evident. The charming doctors became confused, and then like the crew in Coleridge's *Ancient Mariner* — a heavy thump, a lifeless lump, they dropped down one by one.

When Professor Simpson awoke, he found himself prostrate on the floor. His thought was as follows: 'This is better than ether.'

One of the young ladies, Miss Petrie, wishing to prove that she was as brave as a man, inhaled the chloroform, folded her arms across her breast, and fell asleep chirping, 'I'm an angel! Oh, I'm an angel!' — but Simpson searched in vain for the wings.

He soon prepared a paper on Anesthetics which he read before the Medico-Chirurgical Society of Edinburgh, and dwelt especially on the superiority of chloroform over ether. He began at once to use it in his obstetrical practice. One would naturally suppose that the whole world rose as one person and hailed Simpson as blessed, and that women especially felt like traveling from the ends of the earth to cast flowers in his path. Instead of this adulation, however, he was attacked on so many sides that like the lofty Milton he might have said:

. . . . a barbarous noise environs me,
Of owls and cuckoos, asses, apes and dogs.

The controversy grew so bitter that had Simpson been a Semmelweis he might have become insane, and had he been a Horace Wells he would have killed himself. But Simpson was the right man in the right place; he had the courage which defends and the courage which attacks. His was a warm and tender heart, but these desirable qualities did not prevent him from showing proper temper at unwarranted conservatism and unnecessary stupidity. He was no meek-cheeked weakling, and his hand was not lily-fingered. He was the leader of a great battle and he fought with a clenched fist, for the man behind the truth has little time to waste in mewing to the macrobiotic mush of the multitude.

Unfortunately, it was not only the unscientific rabble which shouted at Simpson. Meigs of Philadelphia, Ramsbotham of Great Britain, Scanzoni of Germany — men of brains and skill — opposed the innovation. It seems that whenever a great radical steers his progressive ship over the waves of improvement, there is pitted against him a great reactionist, who by the weight of his authority beats back the advancing craft, and causes it to tremble and flounder among the sands and shoals of established usage.

It is interesting to recall the arguments which were urged against Simpson's introduction of anesthetics into obstetrics. Objections were seldom raised on the ground that the administration of chloroform would prove injurious to either mother or child. The disputants did not claim that the anesthetic would interfere with the natural progress of labor, or impede the uterine contractions, or that there would be an increased elimination of nitrogen in the new-born babe. Such statements — tho incorrect — would at least be entitled to the gravest and most careful consideration. But such arguments were not advanced. Instead, much stress was laid on the fact that an anesthetic sometimes arouses the amorous feelings, and that some women who have been under the influ-

ence of ether or chloroform have confessed that while anesthetized they believed they were engaged in the act of coition. That such occurrences were exceptional and unusual, while labor-pains were otherwise, was not taken into account, and it was both seriously asserted and solemnly maintained that if anesthetics were used in obstetrics the holy pangs of labor would be metamorphosed into exhibitions of sexual passion.

It was further argued that the maternal instinct was in danger of being abolished, as a mother could not love children whom she had brought into the world without suffering.

But even these were not the main contentions. Indeed, they were only breezes in relation to the whirlwind which was to overwhelm him; they were only the lapping of the waves in comparison with the howling storm which was to seethe about him. For, in endeavoring to assuage the pangs of childbirth, Simpson, tho orthodox, had forgotten to reckon with Genesis iii, 16 — the passage which contains God's malediction to mothers: 'I will greatly multiply thy sorrow and thy conception; in sorrow thou shalt bring forth children.'

The parsons got busy. Simpson was denounced as an impious meddler who sought to overthrow the divine decree of Providence. Of course, they called him an atheist, and his followers were considered imps of Beelzebub. Someone quoted Dr Osborn's essay in which the author claims that God's curse as to painful parturition was intended to be continued as long as the world endures, which could be seen by the fact that the erect position of woman's body makes labor more tedious and difficult in her case than in the case of cows, sows and other quadrupeds which have the horizontal form.

But Scripture can be answered by Scripture, and Simpson on his part quoted Genesis ii, 21, in which it is related that when the Lord wished to take a rib from Adam in order to make Eve, he 'caused a deep sleep to fall upon Adam, and he slept.' This citation helped to dispel prejudice in some quarters. It was seen that God himself made use of anesthetics in difficult operations!

Yet it is impossible to predict what would have been the immediate fate of anesthetics in general, and chloroform in particular, had not Simpson unexpectedly found an almighty ally, stronger than a fort of facts, more powerful than an arsenal of arguments. Darwin had a first-rate bulldog named Huxley which showed its teeth when its gentle master was attacked, but Simpson had a mastiff that disarmed criticism and made further abuse impossible. Queen Victoria was pregnant; there was a quickening within the royal womb; the day for labor arrived; Dr Snow stood by her bedside; he put something on her face, and the regal mother inhaled chloroform. A few years later England's Queen conceived once more, and on the approach of parturition again availed herself of Simpson's anesthetic.

What had become of blasphemy? Where was sacrilege now? How about that passage in Genesis? Who now dare call anesthesia an invention of the devil? Did not God's right-hand favorite approve of it? Instead of a heretic Simpson became a hero; he was no longer a rebel, but a savior.

Queen Victoria seemed grateful to the man who had eased her passage thru life, for in due time the baker's son had a Sir in front of his name and a Bart. after. The doctor adopted for his coat-of-arms the rod of Æsculapius over the motto *Victo dolere!* Oxford gave him a D. C. L., Edinburgh has his statue, and his bust stands in Westminster Abbey.

The times had changed, the times had changed. The old order perished and a better rose from its ashes. A blessing of inestimable value was conferred upon mankind. He who was born of woman had brought unto woman a boon!

(1818-1865)

SEMMELWEIS, THE OBSTETRICIAN

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Permit me further to express the holy joy with which I studied your work, *Die Aetiologie*. In the course of a conversation on the subject with a colleague here, I felt myself compelled to declare: This man is a second Jenner; may his services receive a similar recognition and his efforts bring him the enjoyment of a similar satisfaction. . . . It has been vouchsafed to very few to confer great and permanent benefits upon mankind, and with few exceptions the world has crucified and burned its benefactors. I hope you will not grow weary in the honorable fight which still remains before you.

Dr KUGELMANN: to *Semmelweis*.

THE great Lying-in Hospital of Vienna is divided into two sections: the first obstetric clinic is for medical students, and the second for midwife-pupils.

The medical profession has often been accused of overdrugging, but the Vienna School of the nineteenth century had no *materia medica*. This school produced no therapeutists: it forgot that a physician should sometimes cure. 'Doctor, what medicine shall I take?' asked the invalid who had been treated merely as an object of scientific investigation. 'Oh,' exclaimed the Viennese medicus, as if surprised at the question, 'that is immaterial.' If the sufferer still insisted on treatment, he was given a standard prescription which the apothecary read as follows: 'R — A little bitter-almond water mixed with considerable common water, sweetened and fortified with syrup.'

Skoda was enthusiastic in making diagnoses, and Rokitansky in performing autopsies — and if the diagnosis and the autopsy agreed, the patient was not supposed to complain. The dissecting-room was their temple, where they devoutly prayed to be admitted to the inner mysteries of diseased organs. The cadaver was considered the noblest work of nature. The subject of pathologic anatomy was immensely en-

riched, but little was done to heal the sick or save the dying. 'Our ancestors,' said Professor Dietl, 'laid much stress on the success of their treatment of the sick; we, however, on the result of our investigations. Our tendency is purely scientific. The physician should be judged by the extent of his knowledge and not by the number of his cures. It is the investigator, not the healer, that is to be appreciated in the physician.'

The students whom we see in the First Clinic have just come from post-mortem examinations, and are waiting for an instructor to take them to the obstetric cases. They have washed their hands with a squirt of water, and are now drying these organs by blowing on them, waving them in the air, or sticking them in their pockets.

'Oho, Marcus, how would you like to have a sweetheart like that?' asks a future accoucheur, indicating a woman with a meteoric abdomen.

'Why, Franz, that looks like the girl you were walking with last night.'

'Oh, you old bugger! I was with your own sister the whole evening.'

'You lie! Lilly said she was going out with a gentleman, so it couldn't have been you.'

'I swear that I and no other — but Heavens! how the Fräulein can drink! Tokayer — a bottle; Pfaffstättner — a bottle; Gumpoldskirchener — a bottle. I have no money left. Loan me a few gulden, will you?'

'So you can make my sister drunk? Why don't you take the girl to church?'

'Stop that squabbling about Fräulein Lilly, fellows; here comes —'

The teacher enters the clinic, but the amused smirks of the students have already been succeeded by studious looks. Their instructor is Professor Klein's assistant; he answers to the German name of Dr Semmelweis, but he is a true Magyar, born in Budapest, and he speaks German with an accent and

writes it with a hitch. Altho he is getting bald, he is still in his twenties: only a few years ago he lived and laughed in the Josefstadt — the Latin-Quarter of Vienna. He is genial, sympathetic, soft-hearted; the quintessence of goodness is revealed in his open smile.

He leads the way thru the wards, pointing out the interesting cases, and directing physical examinations to be made.

Suddenly he stops; his brow contracts on the bridge of his nose. Before him lies a young mother exhibiting the symptoms of puerperal fever. He remembers her — three days ago he delivered her of a healthy infant. Parent and child seemed to be doing well, but now the curse of the lying-in hospital smites them. Unlike Jules Clement, Semmelweis is not accoucheur to Mlle la Valliere, or any other royal mistress, but every servant-girl entrusted to his care he treats as tenderly as if she were a queen upon whom rested the hopes of a dynasty. For a moment he forgets his students and gazes with compassion at the stricken woman. A cold wave sweeps along her spinal cord, her pulse gallops, her skin is hot and dry, her breathing short and hurried, her countenance sunken and anxious, and at night she mutters in a lethal delirium. She is sick, and next week she will be dead.

The Assistant dismisses the students from his clinic, but he cannot banish the subject from his mind. He goes out, hurries along the Haupt-Allée, past the superb chestnut trees, the epauleted officers, the prancing horses, the beautiful ladies.

He walks unheeding, while all the time his ear-drums half burst from the loud queries that ring thru his head: Why do they die? What is childbed fever? How does it enter the lying-in chamber?

He has read all the books he could find on the subject, and the various theories of distinguished obstetricians flit thru his mind: 'It is due to the milk,' says Boer. 'It is epidemic,' announces Klein. 'It is caused by lochial suppression,' thinks Smellie. 'Miasma is responsible for it,' declares Cruveilhier. 'It is a gastric-bilious disturbance,' writes Denman. 'Its

etiology is found in peritonitis,' argues Baudelocque. 'Erysipelas of the bowels is the predisposing factor,' opines Gordon.

The conflicting notions fill Dr Semmelweis with despair. Who knows which is the correct solution, or if any are true? We grope in darkness; all is chaos and doubt; nothing is certain — except that the number of women who die in child-birth is appalling. In the holiest hour of her life the woman is beaten down by an unknown hand. And the physicians who should save her, stand helplessly by — discussing etiology.

The young doctor thinks and thinks. He is a favorite of Rokitsansky, and in the early morning, before his duties in the hospital begin, he examines and operates on the females who died from puerperal fever, or any diseases peculiar to women. But nothing that he has ever observed can furnish an inkling of the truth.

What mystery of medicine is this which carries off women without a determinable cause? Pregnancy is not a nine months' disease; it is natural, and healthy puerperants should not succumb. And here is the strange part of it all: the maternity hospital is divided into two divisions: the first for medical students, and the second for midwives. The conditions are identical in each, and yet so many more die in the first division than in the second. The first clinic has long had a bad reputation, and therefore the second ward is always more crowded, and yet the mortality continues to be higher in the first. Why should this be?

Fear of the first division is claimed to have something to do with the matter. But a psychic state can never produce such anatomical changes as are seen in puerperal fever.

They say the women are ashamed to undergo parturition in presence of the men, and therefore die from modesty. But how can a condition of mind cause a gangrenous endometrium?

They speak of epidemic influences. But why should an epidemic spare one clinic and attack another, when both are

under the same roof? Besides, when the fever rages at its worst in the hospital, the women delivered in their homes are not affected more than usual. An epidemic is not limited by walls: cholera spreads over a wide area.

It is said that so many of the women die because they are unmarried and have been seduced. But this cannot explain the difference in the mortality of the two divisions, since exactly the same class of patients are admitted to both clinics. Moreover, nature never feels outraged because the mother does not possess a marriage-ring.

It is argued that the medical students examine the women in a rougher manner than do the midwives, and thus cause injury which results in death. But certainly a uterus enlarged by a fetus can tolerate the most ungentle index finger.

They say the ventilation is wrong, but the same method of allowing air to enter is employed in both divisions.

It is all nonsense to talk about the diet, the warming, the washing. The same caterer supplies food to both divisions; the same washerwomen clean the linen of the first and second clinic.

The women surprised by labor in the streets, who give birth to children on door-steps and under arch-ways, tho the day be cold or the night stormy, are not attacked by puerperal fever. Why, women of the country, gored open and delivered of their seed by the horns of maddened bulls, have a better chance of life than the pregnant female who comes to lie in the First Obstetric Clinic of Vienna's Maternity Hospital.

Thus musing, the distracted Assistant finds he has walked far out—to the Central Cemetery, where reposes the illustrious dust of Beethoven and Mozart and Gluck and Schubert. But Semmelweis is not in a mood for melody. The subtle and resistless onset of puerperal fever, the vacant chair by the desolated fireside, the straight road from the marriage-bed to the dead-house, the husband undone and a baby for a salaried wet-nurse,—these are the discords which afflict the sensitive Hungarian who has taken the vow of Hippocrates.

He has reached the environs of Vienna. In the distance, seeming to come from the left bank of the Danube, in the direction of the battlefield of Wagram, he hears the note of a church-bell. He starts disagreeably at the sound. He has heard that doleful tone too often of late. At the Clinic, when the end draws near, and the priest bears the last sacrament to her who bids the world farewell, a bell is rung to mark the passing of a soul. And this frequent, solemn tolling jars with strange effect the nerves of the doctor.

He turns homeward: the problem yet unsolved, still in the grip of a hideous malady. Everywhere is endless confusion; only this much proven: they die, they die, they die. Again the bell clangs: it is an exhortation, O Semmelweis! to be clear of vision and find the source of childbed fever, so the mothers of the race may conceive in safety, and breasts ripe for nursing will not shrivel till the love-fruit takes its fill.

In the early spring of 1847,—the same year that Oliver Wendell Holmes became Professor of Anatomy at Harvard—Semmelweis went for a short vacation to Venice, but unlike Byron, he did not lean back in a gondola with voluptuous languor, while a black-eyed Venetian girl opposite read the tales of Boccaccio.

On the twentieth of March he returned to Vienna, and a few hours later was at his post, prepared to resume his duties with renewed ardor. But the first news he heard was the sad fate of Kolletschka, a friend whom he highly esteemed. Kolletschka was Professor of Medical Jurisprudence, and while performing a post-mortem examination in a medico-legal case, was accidentally pricked on the finger by the knife of a pupil. Thru the tiny stab-wound the poison from the scalpel's tip entered, and inflammation ran wild in the Professor's body: lymphangitis, phlebitis, peritonitis, pleuritis, meningitis. Blood-vessel and lymph-channel conveyed the infection to his eyes, and Kolletschka was sightless and lifeless before Semmelweis returned from feeding the pigeons that fly below the golden horses of St Mark.

As Semmelweis listened to the details of the case, to him as to Porphyro on a sweeter occasion, 'a thought came like a fullblown rose, flushing his brow, and in his pained heart made purple riot.' Lymphangitis, phlebitis, peritonitis, pleuritis, meningitis,—these were the symptoms observed in women who perished of puerperal fever. Semmelweis saw that Kolletschka and the puerperal women died from an identical cause — from septic infection, from poisoned cadaveric material absorbed by the vascular system. Puerperal fever was not a malady unique in nature — it was simply a form of pyemia!

Now it became clear why the mortality of the first obstetric clinic was so much higher than the second: the instruction of the midwives did not include work on the cadaver; therefore they did not often come into contact with decomposing organic matter. But pathologic anatomy was all the rage in Vienna, and the medical student had an overdose of dissection. From the dead-house they came to the labor-ward, and with hands to which the cadaveric particles still adhered, poison lurking behind every finger-nail, they examined the pregnant, parturient, and puerperal women. And the gaping genitals freshly wounded by travail, the denuded surface of the vagina, the fissures about the fourchette, the lacerations near the mouth of the womb, easily sucked up the noxious virus that spelled disaster and death.

A little later Semmelweis discovered that not only decomposing cadaveric matter, but that putrid matter derived from living organisms, and even the atmosphere when overloaded with foul exhalations, may produce the dreaded septicemia. After this, the students who came to the First Clinic found a new rule: before touching a woman they must disinfect their hands with a solution of chlorinated lime. This was the introduction of antiseptics into obstetrics. Immediately the slaughtering of the mothers was lessened, and soon — for the first time in the history of the Vienna Lying-in Hospital — the mortality in the First Division fell below that of the Second Division. A chunk of chloride of lime upsetting a hundred

theories, accomplished this miracle. Now to proclaim the Doctrine to the whole world!

Semmelweis had reason to congratulate himself: the next day the three greatest men in Vienna were his disciples. Skoda referred to his discovery as one of the most important in the domain of medicine. Rokitansky at once accepted his new etiology of puerperal fever. Lest it be deemed strange that a man whose days were spent in the dissecting-room should be so alive to new ideas, we must say that Rokitansky kept sweet and sane by memorizing Kant and marrying a singer. Hebra, who knew so much about itch that we call him the Father of Modern Dermatology, was editor of the *Journal of the Medical Society of Vienna*, and wrote a couple of articles in which he linked the name of Semmelweis with that of Edward Jenner. In return for the compliment, Semmelweis acted as accoucheur in Frau Hebra's next confinement, and his skilled and sterilized hands delivered the good woman in safety.

But not many were as clear-headed as this triumvirate, and misoneism,—that insidious inertia of the mind which makes mankind averse to innovation,—soon asserted itself in clinic, hospital and lecture-room. Semmelweis awoke and found himself famous — and hated.

At this period, however, something happened in Europe which caused even Semmelweis to forget puerperal fever. A nobler fever attacked Mother Earth—the fever of 1848. This was the year in which barricades rose like magic to the sound of the singing of the Marseillaise; the year of Mazzini and the Roman Republic; the year of Garibaldi and his red-shirts; the year of flying popes and abdicating emperors; the year of overturned thrones and angry peoples; the year when the workingman's pike was aimed at the monarch's scepter; the year of endless courage and divine defiance; the year of young blood and new life.

Knout-cursed Russia did not tug at her chains, but every other nation leaped up in fiery revolt. Of course, Austria was

all turmoil, for Austria, the lengthened shadow of Metternich, was the chief oppressor of western Europe. The university students of Vienna, cursing the prince's cruelty, broke into Metternich's home, and drove the old monster over the continent.

Professors and pupils, physicians and lawyers, formed an Academic Legion. Ferdinand Hebra, tho more accustomed to dermatologic eruptions than to political ones, enrolled as a member. Ludwig Frankl, the Jewish poet-physician, joined the students; he wrote *Die Universität*, which twenty composers set to music, while half a million copies went thru Austria and Germany. Ernst Krackowizer, the first person in Vienna on whom the anesthetic properties of chloroform were tried, unsheathed his sword for freedom. And when the reactionary Professor Klein walked thru his clinic, whom should he see arrayed in the uniform of the revolutionary Legion, but his assistant, Dr Ignaz Philipp Semmelweis. He could hardly recognize him at first because of the broad hat with the waving plume. And what was it he held in his hand—a scalpel or a sword? Hippocrates was supplanted by Louis Kossuth.

In Berlin the worthiest sons of Æsculapius acted in the same way. Rudolph Virchow was deprived of his posts by the Prussian authorities, and another turn of the fickle wheel of fortune might have snuffed out his life. Physicians have not yet discovered the drug that ensures perpetual youth, and few who warmed their hearts in the sacred blaze of 1848, are now alive. Yet we all know one physician who was then in prison for liberty's sake, and still lives and practices his profession, and has recently become the President of the American Medical Association: Ave Magister, Abraham Jacobi!

Magyarland, under the brilliant leadership of Kossuth, was gaining its independence. But the strong Czar poured his armies into Austria, and a hundred thousand armed Russians trampled out Hungary's freedom. The flame of rebellion flickered low, and 1849 was the year of reaction. The barri-

cares were razed to the ground, the Marseillaise were sung no more, the aspirations were quenched, the monarchs returned, a host of revolutionaries — those who escaped death and dungeons — flocked to England and America, while several who were not too deeply compromised sought to resume their former positions.

Semmelweis came back to the Obstetric Clinic, and found a new proof of the truth of his doctrine: during the month of March, 1848, such excitement had prevailed in Vienna, that the parturient women in the lying-in hospital were practically neglected, and that was the only month in which not a single death or sickness occurred.

Semmelweis and his companions decided to carry on their propaganda, not thru pamphlets or the press, but by private letters addressed to various teachers of midwifery.

Professor Michaelis of Kiel, whose work on the *Obliquely Contracted Pelvis* is still famous, received one of these letters and was impressed by the contents. Michaelis, a conscientious man, was much worried over the prevalence of puerperal fever in his clinic. In fact, not being able to cope with the situation, he found it necessary to close the hospital for a time. He now introduced Semmelweis's method of chlorine disinfection, watching results, and the outcome was this: no more puerperal fever. Michaelis was profoundly grateful, and regarded Semmelweis as a benefactor of the human race.

A scourge abolished! The excellent professor hummed in satisfaction, but a shooting pain broke off the song on the penult of a word. His niece, his beloved niece — what dreams she had when she felt her babe move within her — already in anticipation she saw her child climb to distinguished heights — how anxious she was to sew a coverlet with which to warm the little stranger on his first appearance — and she had trusted her uncle — so innocently she had looked up in his face and put her doubly-precious life in his hands — and with these same hands he had murdered her — with these stained hands he had conveyed puerperal fever to her, and her dreams

were done — she wrapped the sheets of the childbed around her as a snowy shroud, and said Good-by, and died. The warm-hearted Michaelis recoiled at the unlivable horror of the thing. Something sticky seemed to cling to his fingers. These fingers killed her, and she did not even reproach him. But how the keen voice of remorse breathed hot into his ear. Michaelis rushed from his house. His darkened eyes saw nothing, but he heard a train with snorting breath rumble over the parallel rails. He advanced feverishly, threw himself upon the trackway, and when the locomotive passed there was only a book on *The Contracted Pelvis* to keep alive the name and fame of Professor G. A. Michaelis of Kiel. So the gospel of Semmelweis was sanctified by a martyr's blood.

Semmelweis was likewise forced to admit that he himself had been the harbinger of death in many households: 'When an assistant took special interest in pathologic anatomy, and made many post-mortem examinations, the mortality was high. Consequently must I here make my confession that God only knows the number of women whom I have consigned prematurely to the grave. I have occupied myself with the cadaver to an extent reached by few obstetricians. However painful and depressing the recognition may be, there is no advantage in concealment; if the misfortune is not to remain permanent, the truth must be brought home to all concerned.'

Correspondence was also entered into with Simpson of Edinburgh, who introduced anesthesia into obstetrics the same year that Semmelweis introduced antiseptics. Simpson read the letter in haste, and replied with a Scotch accent: He knew without being told how filthy the maternity hospitals in Germany and Austria were; he knew that the high mortality was due to the criminal carelessness of placing a healthy lying-in woman on the same bedclothes and linen in which a parturient woman had just died; if Semmelweis and his friends would take the trouble to read British obstetric literature they would see that Englishmen had long been aware of

the contagious character of puerperal disease and had employed chlorine disinfection for its prevention.

From the above it will be seen that Professor Simpson confused the English theory of the specific contagiousness of puerperal fever — a disease communicated by the sick puerperant to the healthy one, or transmitted by the physician who had confined a woman suffering from the malady — with the Semmelweis doctrine of its causation by the absorption of putrid matter from a living organism or cadaver, producing a pyemic blood-dissolution.

It will be recalled that these English opinions were copied and adopted in 1843 by Oliver Wendell Holmes, in his immortal essay, 'The Contagiousness of Puerperal Fever.' Yet in Siebold's standard *History of Obstetrics* there is no mention of Dr Holmes. Such accidents seem liable to occur: Baker Brown actually wrote an historical sketch of Ovariectomy without referring to Ephraim McDowell. It is true Holmes did not devote much time to puerperal sepsis. He wrote his one essay on the subject, and set it adrift in a quarterly medical magazine which suspended publication within a year. But the man and his work could not perish — especially as the eminent Professor Meigs denounced him with the same virulence that he opposed Simpson's use of chloroform in labor. There is no passage in medical literature more frequently quoted than Holmes' concluding appeal: 'The woman about to become a mother, or with new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law, brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in the hour of peril. God forbid that any mem-

ber of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly, or selfishly.'

A closer examination of the subject convinced Simpson that the English and the Semmelweis etiology were not identical, and since he was J. Y. Simpson, he acknowledged his mistake. From that time on, aided by his well-known assistant, Matthews Duncan, he preached the truth regarding puerperal sepsis, and it was due chiefly to the efforts of his school that British obstetrics outstripped and long outranked the continental tokology.

About this period, an honor was conferred upon Semmelweis. Dr Karl Haller, an influential man, a director and senior physician of the General Hospital, suggested that Semmelweis be invited to address the Vienna Medical Society on his experience with puerperal fever. The motion was adopted, but Semmelweis voted in the negative. In truth, he had never spoken to an audience, and the mere thought of it gave him stage-fright — an evil which a solution of chlorine could not remove. Finally he was prevailed upon to appear, and he produced an excellent impression. The discussion that followed was certainly pleasing to Semmelweis. Rokitansky, who presided, spoke in his favor; brave Chiari — son-in-law of Klein — voiced his approval; Helm and Arneth called the young discoverer a benefactor, while Skoda, Hebra, and Haller applauded.

It was a great triumph for the humble assistant, but it aroused his enemies to action. Rosas cursed him; Klein frowned heavily when he met him; Scanzoni — the snake of midwifery who rattled his fangs also at Simpson — poured venom at him; Bamberger attacked him; Kiwisch insulted him; Lumpe laughed at him; Seyfert spat at him.

By this time Semmelweis's assistantship had expired, and he applied for an extension of two years more, as his predecessor in the First Clinic and his colleague in the Second Clinic had successfully done. But the authorities were against Sem-

melweis. It was not forgotten that he had served in the Academic Legion. The stupid Klein took his revenge; his pursed-up lips meant, 'I want to be rid of you.' Semmelweis then petitioned to be appointed Privat-Dozent of Midwifery. After a rather long wait — from March, 1849, till October, 1850 — he received the position, but with galling restrictions; he could not grant certificates of attendance like other dozenten, and he could demonstrate not on the cadaver, only on the manikin. Semmelweis was an emotional man. He was a scientist, but with the artistic temperament. He was terribly enraged, and made up his mind to shake the dust of Vienna from his feet. He acted unreasonably, and did not call upon Rokitansky; he did not bid farewell to Hebra; he did not shake hands with Skoda. He simply packed up his belongings, and started for Budapest. Ignaz Semmelweis is a type that Tragedy loves to mark as her own: intense, impractical, uncompromising. Too unworldly to look after his personal interests, too honest to make terms with popular falsehood, he was predestined for the road of bitterness, and the crown of thorns awaited him.

Twelve years ago, as a pleasant youth of nineteen, Semmelweis had left Budapest to enter the University of Vienna. Now he came back to his birthplace, immortal but unsuccessful. His home-coming was not a happy one. His parents were dead; his brothers, who had taken their share in the revolution of 1848, were refugees; there remained to him only one brother, who was a parson, and one sister, who was married.

The sight of houses and landmarks intimately known in former days brought back a thousand recollections of boyhood, and he could but smile that so many trivial and even silly incidents should crowd upon his memory. After all, he was not sorry to leave Vienna, and he whistled a snatch from Petöfi, but stopped in amazement to look at the majestic Suspension Bridge which had been completed the year before by the English engineers, Tiernay and Adam Clark. Then

he strolled reminiscently thru the street where his father had kept a shop.

Semmelweis felt a subtle sympathy for his country, which, like himself, had been conquered by the powers of darkness: stabbed by Windischgratz, hanged by Haynau, knouted by Nicholas. Only a year before Semmelweis returned to Budapest, Louis Batthyani, the distinguished Hungarian patriot, had been caught there, court-martialed, and shot. The prison-odor still clung to Balassa, the professor of surgery. Semmelweis did not really escape Vienna: all over Hungary's capital the superfluous men known as state-agents eavesdropped and peeped; spies — nasty, sneaky, crawling, slimy creatures, forever pilloried by the grim pen of Maxim Gorky.

The Hungarian Academy of Sciences was closed by pleasure of the law, and the Medical Society of Pest could not meet unless a policeman was present. Semmelweis sighed — what else was there to do? He claimed he did not know how to write, so he could not find solace in the ink-bottle. But he seemed to experiment on the value of doing nothing. He who had been indefatigable became the apostle of apathy, the lord of laziness, a very prince of procrastination.

But such a state of affairs could not last long: Professor Klein did not send Semmelweis money to live upon. Semmelweis had his choice: either make an honest living as a respectable member of organized society, or join a roving gypsy-band and pitch a tent and swing a kettle on any hillside — in which occupation he would have been as comfortable as a frog in acetic acid.

When Rogers saw Lord Brougham ride off one morning, he remarked, 'There go Solon, Lycurgus, Demosthenes, Archimedes, Sir Isaac Newton, Lord Chesterfield, and a great many more all in one post-chaise.' A similar compliment could not be paid to Semmelweis. He was not a versatile man. He knew his branch of medicine, and nothing more. In fact, he was a man of one idea — but it was a great idea.

Semmelweis now petitioned to be appointed director of the

Obstetric Division of the St Rochus Hospital, a cheerful institution, with windows suggestively overlooking the cemetery. His application was successful, and as soon as he entered he introduced chlorine disinfection. The mortality at the hospital decreased so swiftly and surely that the fame of Dr Semmelweis spread thruout Budapest. It boomed too his private practice; his office now contained more than one patient at a time.

Thus matters went on for about five years; then Hofrath Birly, the incumbent of the chair of midwifery in the university, was elegized by his friends, and wreaths were placed upon his coffin. A professorship — fortunately — is not hereditary, and the question arose: Who will succeed old Birly? It is pleasant to record that, in July, 1855, Ignaz Semmelweis was appointed Professor of Theoretical and Practical Midwifery in the University of Pest.

There is no tonic in any Pharmacopeia equal to the elixir of success. Success — it is iron, mother's salve, digitalis, capsicum plaster, catarrh snuff, Godfrey's cordial, Hoffman's anodyne, Seidlitz powder, brandy and hasheesh all in one. Success purifies the blood, it draws the tip of the chin in, it throws back the shoulders, it straightens the spinal column, it gives color to the cheeks, and brings luster to the eye. The Herr Imperial Royal Professor Semmelweis walked with a jaunty air. He was enthusiastic, and determined to make Budapest the medical Mecca of the world.

When an affectionate bachelor finds himself living on Easy Street, he is apt to speculate in the matrimonial market, especially if a sweet girl like Marie Weidenhofer seems to be fond of him. Ignaz was a bald-headed professor of thirty-eight; Marie was a charming *fräulein* of eighteen, but they now promised to love each other as long as they lived, and never to quarrel, or cause each other jealousy. How it happened that a shy man like Semmelweis took advantage of the psychological moment is more than we can presume to explain. The best we can do is to quote from Lillian Bell, who exposes

all the secrets of sex: 'Proposing,' claims this lady, 'requires a sort of plunge; a burst of courage; a bravery which must be pumped up for the occasion, and that sort of thing your shy man is used to. He cannot even ask a girl to take a walk with him without perspiring under his hatband, so he is accustomed to being afraid and going home without having done it and then longing for it in secret, and finally, goaded to desperation, of making a bolt for it. That is the history of his daily emotional life.'

It is fortunate that Semmelweis could now find consolation at home, for the school-year 1857-8 was a frightful one: four per centum of the women in his Lying-in Hospital died from puerperal fever. How Carl Braun and Scanzoni would jeer at him! What was the cause of this dreadful slaughter? When Semmelweis had first assumed charge of the obstetric clinic, he found that the women lay 'upon filthy sheets which actually stank of decomposed blood and lochia.' Enraged at the circumstance, he pulled the unclean linen from the beds, gathered it into a pile, and rushed to von Tandler, the official in charge. 'Smell!' shouted Semmelweis, shoving the foul bundle under his nose. After this practical appeal to the olfactory organ of the Statthaltereirath, the laundry contractor was requested to wash the soiled linen before returning it. So the Lying-in Hospital now had clean sheets, chlorine disinfection of course was employed, and yet here was a mortality of 4 per cent. What evil agency was at work, destroying lives with an invisible hand? Semmelweis did not sleep till he discovered the cause: a careless nurse. Either some students had bribed her to disobey the professor, or she herself had no interest in his hobby, because she made it a rule never to go to the trouble of changing sheets, even in the bed in which a patient died from puerperal fever. An expensive idiosyncrasy: it cost 18 out of 449 lying-in women their lives. Semmelweis discharged the culprit whose treachery had brought about the four per centum mortality. A nurse trained in his own prophylaxis — it was enough to make a man go mad.

Semmelweis indeed had reason to be unhappy. His Doctrine made little headway. He could not lift the boulder of prejudice that lay in the path of medical progress.

Primerose and Riolan attacked Harvey's discovery, but denial of the circulation of the blood never injured anyone's health. Many did not accept Newton's law of gravitation, but this stupidity was not followed by symptoms of pyemia. Dr Ohm was considered unbalanced, but failure to comprehend the unit of electrical resistance did not result in phlebitis. Galvani was ridiculed as the frog's dancing-master, but inability to appreciate the value of galvanism never caused lymphangitis. Cuvier vanquished Lamarck, scoffed at the idea of fossil man, and pitched the bones out of the window in a rage. Scientific progress was thus hindered, and the doctrine of Evolution delayed for a generation, but no man died from metastases because he failed to greet the monkeys in the zoological garden as his long-lost cousins.

But to hold erroneous views on the etiology of puerperal fever meant that thousands of wrongly-trained practitioners and midwives went yearly forth to spread disease and death; it meant that countless hosts of mothers were wantonly massacred in state-supported murder-dens. 'To be laid on the confinement bed,' said Fritsch, 'was the same as to be delivered to the hangman.'

As late as 1860-3, Achilles Rose was a student at the University of Jena, and he records that during that period no lying-in woman left the institution alive. 'All died,' he writes, 'from puerperal fever. Disinfection of the hands, insisted upon by Semmelweis, had not received any consideration, even by such an eminent man as Professor Schultze.'

But an intellectual giant — beside whom the eminent Prof. Schultze was insignificant — saw no good in Semmelweis. To claim that Virchow is one of the greatest sons of Hippocrates is unnecessary, because it is undisputed. But there was this difference between the Greek and the German: the latter had limitations. His opposition to Semmelweis was by no

means his only sin. Certainly his attitude on the germ question was not to his credit: 'I must ask my friend Klebs to pardon me,' he said, 'if, notwithstanding the late advances made by the doctrine of infectious fungi, I still persist in my reserve as far as to admit only the fungus which is really proved, while I deny all other fungi so long as they are not actually brought before me.' When Haeckel desired that Evolution be included in the curricula of the public schools, Virchow took the contrary view—with vehemence. Virchow claimed there was an essential difference between the skull of primitive man and the ape, arguing that no human being had an orbital stricture as pronounced as is found in the *Pithecanthropus*. The words were hardly out of his mouth when Nehring found a skull of a Brazilian Indian in the Sambaquis of Santos, in which the stricture was deeper than in many of the apes. And then how puerile was Virchow's warning, 'Darwinism leads to Socialism!' Since when has it been the duty of the scientist to worry what anything leads to? It is the function of the scientist to find the fact and accept the conclusion, be it saccharin or gall. It may be unpleasant to contemplate that man is a freak of nature, and will ultimately disappear from the earth, but if such be the facts, then scientists must announce them, or cease to lay claim to the title of truth-seekers. Virchow's admonition deserves to be placed by the side of Agassiz's complaint, 'Darwinism seeks to dethrone God, and replace him by a blind force called the law of evolution.' Virchow's attitude towards Darwinism was so unfair, that the ever-gentle Darwin, who could rarely be provoked to retort, wrote to Haeckel, 'Virchow's conduct is shameful, and I trust he will one day feel the shame of it.' But Virchow evidently did not repent, for as late as 1894, at the Anthropological Congress in Vienna, he said, 'a man might just as well have descended from a sheep or an elephant as from an ape.' Virchow, in later years, liked to speak of 'the point where science makes its compromise with the church.' Perhaps this is the reason why Virchow

is thrice quoted with approval in J. J. Walsh's *The Popes and Science*, an alleged medico-historical volume, recommended by Archbishop Farley and dedicated to Pius X on Our Lady's Day. Shall we say of Virchow as Nietzsche said of Wagner: 'He succumbs at the cross of Jesus Christ?' But Father Time has amusing little tricks of his own: yesterday, Rudolph Virchow, the scientific founder of cellular pathology, rejected Darwinism, and to-day the Jesuits themselves are accepting it!

Semmelweis now saw that he must do what he had long declared he could not do — write a book. 'I cannot write,' he told his devoted friend Markusovsky, who continually urged him. 'I have a congenital aversion to all that is called writing.' But the groans of the lying-in women dying of childbed fever caused by the pupils that Carl Braun and Scanzoni sent out into the world, thrust the pen into unwilling fingers.

One day in 1860 Dr Hirschler was strolling along the streets, when he was seized by an excited individual who insisted that he come to his home at once. Dr Hirschler complied with the urgent demand, and no sooner did the friends seat themselves than the host opened a drawer, pulled out a huge manuscript, and began: 'My Doctrine is not established in order that the book expounding it may molder in the dust of a library: my Doctrine has a mission, and that is to bring blessings into practical social life. My Doctrine is produced in order that it may be disseminated by teachers of midwifery, until all who practice medicine, down to the last village doctor and the last village midwife, may act according to its principles; my Doctrine is produced in order to banish the terror from the lying-in hospitals, to preserve the wife to the husband, the mother to the child.'

So Hirschler learnt that Semmelweis had at last completed his book: *The Etiology, Nature, and Prophylaxis of Puerperal Fever*. Semmelweis had underrated his literary ability: he *could* write. As far as its scientific value is concerned, no

praise can be too high: page after page could stand, without revision, in the most modern treatise on the topic. Arnold Lea's *Puerperal Infection* just off the press and fresh from the bindery, does not antiquate Semmelweis's work — it supplements it.

But the book did not sell. And the lecture-rooms still echoed with ancient nonsense about epidemic puerperal fever, while the examining finger and the operating hand still committed murder. Semmelweis called his discovery 'the puerperal sun which arose in Vienna in 1847,' but its rays were dimmed by Breisky mist and obscured by Carl Braun clouds.

Semmelweis was a disappointed man. He became bitter, irritable, old. Sometimes when he smiled to his wife, she saw how weary he was. But Semmelweis had learnt the lure of writing, and the pen was now his constant companion. And this instrument which he had hitherto feared became in his hands a burning lash and a flaming sword.

In Disraeli's *Quarrels of Authors*, there is no controversy more fierce than Semmelweis's *Open Letters to Professors of Midwifery*. In these letters we do not recognize the gentle man of earlier days; we see instead an exasperated antagonist, desperate, emotional, fanatical, furious. 'My Doctrine,' he writes to Scanzoni, 'is based on my experience. Your teaching, Herr Hofrath, is based on the dead bodies of lying-in women slaughtered thru ignorance; and I have formed the unshakable resolution to put an end to this murderous work as far as lies in my power. If, Herr Hofrath, without controverting my teachings, or giving reasons for assuming them erroneous, you continue to teach your students the doctrine of epidemic puerperal fever, I denounce you before God and the world as a murderer, and the History of Puerperal Fever will not do you an injustice when, for the service of having been the first to oppose my life-saving *Lehre*, it perpetuates your name as a medical Nero.'

These terrible *Open Letters* only amused the professors.

'Have you been scorched by the puerperal sun?' asked one. 'The Hungarian crank is simply crazy,' said another.

No longer able to control himself, Semmelweis stopped laborers and business-men on the streets, and tried to make them listen to his Doctrine. They tapped their foreheads significantly, and passed on. It was not these people, however, that caused Fritsch's epigram: 'There is a dark chapter in the history of midwifery, and it is headed — Semmelweis.'

During a meal, Semmelweis behaved strangely, and when Marie looked into his eyes she saw that reason had left him. She ran to his friend, the editor of *Orvosi Hetilap*. 'Nonsense,' said the good Markusovsky, 'nonsense, I assure you. He is excited; can you blame him? He will be all right tomorrow. I will come to see him. There is no cause for worry.' But Ludwig Markusovsky knew he lied, for he himself had sickening suspicions.

A few days later it was no longer possible to conceal the circumstances, and it was decided to remove Semmelweis to a lunatic asylum in Vienna, where he would be under the care of Dr Riedel, the eminent alienist. On the last day in July — his birth-month — in 1865, when he was forty-seven years of age, the journey was begun. Some friends and relatives, his wife and infant child, accompanied the invalid. By means of a stratagem, Ferdinand Hebra induced him to enter the asylum. Fifteen years ago, Semmelweis had left Vienna — angry; now he was brought back — mad. Perhaps he had often dreamed of returning, but hardly like this.

Within a day or two it was discovered that Semmelweis had a wound in his finger, the result of his last gynecological operation. Gangrene set in, cellulitis developed along the arm, metastases followed, and soon Semmelweis lay in the dead-house, ready for a post-mortem examination. Just as Laennec died of phthisis, the disease which he had studied above all others, so Semmelweis fell a victim to pyemia, which he had discovered to be identical with puerperal fever, and which he sought to exterminate by antisepsis.

Thee nor carketh care nor slander,
Nothing but the small cold worm
Fretteth thine enshrouded form—
 Let them rave.
Light and shadow ever wander
O'er the green that folds thy grave—
 Let them rave.

But they rave no more. His grave had hardly closed when Pasteur and Lister began to make a microscopic bacterium reveal its deadly secret, and then all the world knew that Semmelweis had been right since 1847, and a magnificent monument was raised to his memory. The great obstetrician is seen in full, holding his book under his arm; on the step of the pedestal sits a woman, with her infant in her arms, gazing reverently at her benefactor. 'I stood to-day with uncovered head by the monument of Semmelweis,' writes Dr W. J. Robinson, from the International Medical Congress at Budapest; 'it is very beautiful, and is kept green and is well taken care of by a special watchman.' Ah, if they had been as tender to the man as they are to his statue, his career would have been happier.

Yet it is well that Semmelweis has been thus honored, and tho that marble mausoleum at Budapest may crumble in the course of centuries, there is one monument to the beloved physician which shall endure as long as the human female bears children: Motherhood is safer because Ignaz Semmelweis lived and worked.

(1804-1881) (1810-1882)

SCHLEIDEN AND SCHWANN



SCHLEIDEN AND SCHWANN

With that grand movement of the biological sciences that began about 1838, and of which we to-day contemplate the superb bloom, two names are inseparably connected—Schleiden and Schwann.

—LEO HERRERA.

MATTHIAS MULLER was a shoemaker, which means that he was poor but honest. Not everyone in his neighborhood was well-shod by any means, and it is absurd for a shoemaker to be idle amongst barefooted people, but this is a mystery of political economy which we must leave to the disciples of Comrade Marx. Had it not been for Napoleon's soldiery who overran the country and needed their boots mended when they visited the farmers' daughters, Müller's wife would have made few visits to the baker. And as all cobblers obey the injunction to replenish the earth, Matthias Müller had a brood to feed.

Little Johannes, for instance, forgot he was a poor man's child, and ate with a royal appetite. Johannes was a sturdy self-assertive lad who wandered all over the town on his bow-legs. Sometimes his mother couldn't find him, and then she was sure he was drowned, for the Müllers lived at Coblenz—where the river Rhine meets the waters of the Moselle.

Once Johannes walked a long way thru the vineyards till he reached an imposing rock at which a group of people were looking. A few of the women had note-books in their hands, and one of the men was standing in front of the others, pointing with a cane and speaking: 'Very long ago, as the twilight came down from the hills, a water-nymph would appear on this rock, and she would sing soft and low until darkness was overcome by light, and day drove the gray mists from the valley. So beautiful was she, as she sat there combing her golden hair by moon-shine, and so sweetly she sang her plaintive lullaby, that whenever a boatman heard her voice he lost

his senses, and swooning with desire he steered toward the maiden. But already when he dreamed of possessing her, he would strike against the reefs and perish. The bold Roland, the son of the Palatinate count, heard of the enchantress, and determined to see her. He took an old sailor with him, and as they rowed towards the cliffs,—’ here the guide spoke confidentially, and Johannes could hear nothing more. But the Müllers did not believe in the Lorelei, for they were good Roman Catholics and had enough legends of their own.

When the boy’s biceps grew shapely, his father planned that Johannes also should work with leather, but not as a cobbler,— as a harness-maker. He would fashion the winkerstraps and the breeching, the check-rein and the belly-band. But the mother demurred—the child was so bright—all the neighbors said so—if they could only send him to the Sekunden Schule so he could become a priest—perhaps they could manage somehow? Matthias Müller sighed and shook his head mournfully—but Johannes was sent to school for all that.

‘During the past several years,’ writes Dr Charles Gilmore Kerley, ‘the sons of shoemakers, carpenters, plumbers, bricklayers, etc., did not wish to follow the occupation of the father. These boys would be lawyers, bank presidents, physicians, and sorry to relate some of them became lawyers and physicians.’

But Kerley is an ass and heredity an illusion: the sons of scholars yawned over their books and tried to bribe the shoemaker’s child to do their lessons. The school-room was to be Johannes Müller’s domain for the rest of his life. Deciding to study medicine he entered the University of Bonn, and at the age of nineteen he secured a prize for his researches into the respiration of the fetus. At twenty-two he was appointed privat-docent; at twenty-five he was extraordinary professor; three years later he was full professor.

In 1833 occurred the death of the distinguished Rudolphi of Berlin, and Müller wrote to the authorities, ‘With the excep-

tion of Meckel no one in Germany can fill this post as well as I.' Evidently this was the same Müller who a few years previous, when wooing a girl, wrote her a poem declaring that as a marriage settlement he offers her no money but an immortal name. But folks were not in the habit of saying to Johannes Müller, 'You are conceited.' Without delay he won Anna Zeiler and Rudolphi's chair.

For twenty-five years he remained Professor of Anatomy and Physiology at Berlin, and during that quarter of a century he was probably the most conspicuous man in the scientific world. Nearly every worker who added a stone to the structure of German science received instruction and inspiration from this great teacher. No single discovery of paramount importance is associated with the name Johannes Müller, but the jewels that he could exhibit were Virchow, Brücke, Henle, Wagener, Helmholtz, Bois-Reymond, Claparede, Ludwig, Schwann, Volkmann, Reichert, Lachmann, Vierordt, Trochel, Kölliker, Remak, Lieberkuhn, Haeckel.

The spirit that animated Müller's lecture-room recalls the days when Plato stood in the Academic Grove, and Aristotle pondered in the Lyceum, and Epicurus philosophized in the Garden, and Socrates walked the market-place followed by his pupils. Students flocked to Müller not merely to pass examinations and receive a diploma—they came with full hearts, in a glowing fervor, like pilgrims to a shrine. To work under Müller was not an incident in one's medical career: it was an epoch never to be forgotten. So magnetic was his personality, a glance from his splendid eyes made such a lasting impression, that in an earlier century Müller could easily have become the founder of a religion. As it was, many felt and claimed that there was the stamp of the supernatural upon him. Emerson wrote an essay on Character, but Johannes Müller lived it.

Only once did Müller come in conflict with his pupils, and then the master's voice fell on unheeding ears. Then the youths who had sat at his feet rose up and deserted him. The

students who had been so proud to work in Müller's laboratory, left the markings on the myograph unvarnished, and the busy reagent bottles were all stoppered — till their necks were incrustated with salt and dust. This was in 1848, when an outraged world revolted. The people defied the tyranny of kings, and the red flag was unfurled in the whirlwind. A pike seemed to be in every hand, and Comrade sanctified every lip. In what hopes, in what dreams of freedom did Young Europe indulge! Such high days do not come again. The lads decided to test theories, not on laboratory-desks, but on the barricades. Müller's Manual of Physiology was forgotten while they read the Communist Manifesto. They sang aloud, not college-songs, but revolutionary hymns. They were ready to take examinations and answer the questions, not in ink, but with blood. They did not stir weak chemicals in frail beakers, but with gunpowder they shook thrones.

But the shoemaker's son set his face against the democratic passion. Müller was the director of the Berlin Museum, and in the clash and shock he feared a pathologic specimen of a guinea-pig's endgut might be damaged. Property seemed more sacred to him than the liberties of nations. An official position is gag and gyves. Only he who is free from purse and responsibility can afford to tell the truth. Decorated academicians in the assembly-hall are never as honest as carousing bohemians in the café. Respectability has its penalties.

The matchless vision of the ideal Republic, which in those days uplifted the souls of Herzen and Petofi and Mazzini and Garibaldi, was not discerned by Müller. One of the rebels — Virchow — has told how, day and night, Müller remained at the museum, ever on guard; he tore down agitating placards; he ventured with personal danger among the students, and on the day of the great citizens' parade the unhappy Professor, with his own hand, seized and tore away the black banner which was stretched across the balcony of the university building.

But everyone felt that altho the Director was mistaken, he was not dishonorable, and when the aspirations were crushed, and the uprooted thrones rested again on the twin-pillars of militarism and clericalism, Müller got back his pupils.

No anti-vivisectionist would imagine he could find comfort from the greatest physiologist of the nineteenth century, but in a panegyric on Rudolphi, Johannes Müller spoke these words: 'Rudolphi looked upon physiological experiments as having no relation to anatomical accuracy, and it is no wonder that this admirable man, who had at every opportunity expressed his abhorrence of vivisection, took up a hostile position against all hypotheses and conclusions insufficiently established upon physiological experiments. . . . We could not have failed to share his righteous indignation had we seen how many physiologists were using every effort to reduce physiology to an experimental science by the live dissection and agonies of innumerable animals, undertaken without any definite plan, and yielding often insignificant results.'

During Müller's first year of medical studies he was starting on a journey by horseback to Arrthal. Along the roadside he espied a pregnant cat, and remembering that he was investigating the respiration of the fetus, he chased the animal till he captured it, and by means of Cæsarean section deprived it of its young. It is questionable if the mature man would have repeated the experiment of the nineteen-year old student, for — as the words quoted above plainly indicate — Müller grew averse to vivisection, and seldom would put a knife into a living warm-blooded animal.

Because of Müller's dislike for the purely experimental part of his science, he became addicted to the descriptive portion of it, and published an enormous amount of strict morphology. Week after week and year after year he enlarged the boundaries of structural anatomy, and altho Müller could rule the double domain of anatomy and physiology, no one else could, and at his death his biological kingdom — like Alexander's empire, as Du Bois Reymond said — was divided among his

followers. Müller's chair was split into three: Du Bois-Reymond took physiology, Virchow took pathological anatomy, and Reichart took morphology.

It is our conviction that the result has been unfortunate. Anatomy, divorced from Physiology, is sterile; yet generations of students have been forced to cohabit with her till they echoed a yawning Amen to Dr Conan Doyle's dictum: 'For him who has mastered Gray's Anatomy, life has no further terrors.' Because of the stress laid on morphology, to-day the entrance to the temple of medicine is by the narrow door of memory, and not thru the broad gate of understanding. Not mental alertness, but an extraordinary amount of *sitzfleisch* is required to be able to remember in detail the surfaces of the petrous portion of the temporal bone. Cramming attracts the grind, but repels the genius. Emphasis should not be laid on those topics which are expected to be forgotten as soon as the quiz is over. Lifeless phraseology and superfluous terminology do not constitute a science. The present method of teaching anatomy, the presentation of a mass of technical description, gross and histological, which must be learned by rote, is not calculated to stimulate the contents of the cranium. The long, dry, useless course in osteology should be abolished, structure should not be taught without reference to function, and the chairs of anatomy and physiology should again be united under a single sceptre.

The development of embryology in the eighteenth century was retarded by the preformation theory which held that on the last day of God's labor he created two hundred thousand millions of human beings in embryo and neatly packed them in the ovaries of Eve, from which they were unfolded generation after generation.

In 1759 a young man, working for his degree, attacked this notion and advanced the doctrine of epigenesis. But Haller, the foremost professor of the age, was a preformationist, and between this potentate of physiology and the unknown Kaspar Wolff there could be no argument. Haller simply laughed,

and no one read the young doctor's thesis. When Meckel translated it in 1812 he had to wipe from its covers the dust of half a century. So effectually was the light of Kaspar Wolff quenched by the Hallerian snuffers that to-day not a single portrait of the founder of epigenesis is extant. No man knows how the greatest embryologist of the century looked.

After Albrecht Haller came Cuvier who was much more mischievous in combating new ideas. During the many years in which his influence was supreme, Cuvier was a veritable barrier obstructing progress. It is a matter for regret that his early ambition was frustrated and that he failed to receive an appointment in the seminary, for he would have done less harm in theology than in science. Furthermore, as a priest he would not have been the foster-father of Richard Owen and Louis Agassiz — two gentlemen who had unusual faculties for committing blunders and corresponding propensities for persisting in them.

Johannes Müller, because he likewise covered the whole field of biology, has often been compared with Haller and Cuvier, but he was the noblest of the three: he permitted contradiction. He did not use the key of authority to lock out a young discovery. Müller lived to see much of his work remodeled by his pupils, but it is his eternal glory that he never attempted to hinder the advance of truth.

Who loves not Knowledge? Who shall rail
Against her beauty? May she mix
With men and prosper! Who shall fix
Her pillars? Let her work prevail.

Among Johannes Müller's favorite pupils was Theodor Schwann. Schwann's parents knew nothing of the limitation of offspring, and had a dozen more children besides himself. His early education was received at the Jesuit Gymnasium of Cologne. It is curious that men should be so touchy about their theology if they chose one form of religion

in preference to another after reaching years of maturity there might be some reason for their standpoint, but nothing is more accidental or artificial than our religious beliefs. Our creeds are prepared for us while we lie in our cradles. If Müller and Schwann had not been born in the old Catholic Rhineland and had not received their first instruction from the Jesuits they certainly would have felt no reverence for the pope's toe. Even from Russian prisons men have been known to come forth uninjured, but no one emerges from a Jesuit's cell unscarred. Laennec and Pasteur were Catholics because they were educated to be Catholics, and Faraday and the chemist Wurtz were Protestants because their parents were Protestants, and ancient Livy believed in Romulus and Remus because he had been thus taught to believe, and in the *Philosophical Dictionary* of Voltaire is a story of an Arab who besides being a good calculator, was a learned chemist and an exact astronomer, and nevertheless believed that Mahomet put half of the moon in his sleeve. Religion is a matter of geography. A man's faith is mapped out for him by his good grandmother, and yet he takes it all so seriously.

By education most have been misled;
So they believe, because they were so bred;
The priest continues what the nurse began,
And thus the child imposes on the man.

Schwann's relatives expected him to be a clergyman like his older brother Peter, and he himself had inclinations for the pulpit, but not being quite decided as to what profession he would follow, he enrolled in the University of Bonn in the class of philosophy, a mixed course which included some instruction in mathematics and science. He thus became a pupil of Johannes Müller, who was experimenting at the time with the spinal nerves of frogs, and when the master said, 'Herr Schwann, you may cut the anterior root,' the youth's destiny was fixed. Müller, the human lodestone, had attracted this student as he did hundreds of others.

Theodor Schwann made up his mind to become a scientist. For two years he studied medicine at Würzburg, then came to Berlin, where he again found Müller, and became, as we have already said, one of his helpers. Schwann's thesis for the doctorate was an embryological subject, and of course the chick was the medium employed. We may almost say that if it were not for the chick there would be no science of embryology — which sounds like Huxley's remark that frogs were invented for biological experiments. When the post of Assistant in Anatomy fell vacant, Müller offered it to Schwann. The duties were strenuous, but fortunately he did not have to lose time debating how to dispose of his salary, since his wages were ten thalers a month.

He retained the position for five years. He was patience personified. He seemed to relish monotony. While preparing the skeleton of a giant ray he would sit for a week and continuously scrape its fins. But as one of his colleagues said, 'Those were great times. Any day a bit of animal tissue, shaved off with a scalpel or picked to pieces with a pair of needles, might lead to important ground-breaking discoveries.' Henle, the author of the above quotation, has left for posterity a verbal portrait of Schwann: 'He was below the medium stature, with a beardless face, an almost infantile and always smiling expression, smooth, dark-brown hair, wearing a fur-trimmed dressing-gown, living in a poorly-lighted room on the second floor of a restaurant which was not even of the second-class. He would pass whole days there without going out, with a few rare books around him and numerous glass vessels, retorts, vials, and tubes, simple apparatus which he had made himself.'

An assistant who is willing to keep himself in the background is appreciated by the Faculty, and as the professors were preparing an *Encyclopedic Dictionary of the Medical Sciences*, the intelligent but unobtrusive Schwann was asked to contribute some articles.

But at this period an event of extraordinary importance

was transpiring at Berlin. Johannes Müller was engaged in preparing his *Handbuch* — the physiological world was being placed between covers — and among those who were selected to assist in the experimental work required, for nothing went into Müller's book until tested by himself or associates, was Theodor Schwann.

Dr Schwann now learnt the joys of research: that peculiar excitement a man feels when he knows something that is not in any text-book. Schwann was in his twenties, but was far more interested in frogs, fibers and sheaths, than in wine, woman and song. He was busy proving the restorableness of cut nerves, inventing the muscular balance, discovering the sheath that bears his name, examining the textures of voluntary muscles, pointing out methods of isolating primary fibres, demonstrating the origin of the transverse striæ of their primitive bundles, showing the muscular contractility of arteries, convincing himself that yeast was an organic growth, experimenting in digestion which led to his discovery of pepsin.

When the great *Handbuch der Physiologie des Menschen* finally appeared, Schwann was gratified to find several references to himself: 'In the crural vein of the ox, Schwann found. . . . I have frequently observed this phenomenon as Schwann has described it. . . . Lastly, Schwann has recently ascertained by means of the microscope. . . . Schwann has proposed another explanation. . . . It has been shown by Schwann to consist. . . . This notion is disproved by the fact that Schwann. . . . Some very accurate experiments instituted by Schwann. . . . According to the observation of Schwann. . . . Schwann inclines to the opinion. . . . My assistant, Dr Schwann. . . . Thus demonstrated by Schwann. . . . Most of what we know about this subject we owe to Schwann. . . . The recent important discoveries of Schwann. . . . The proportion of acid recommended by Schwann. . . . Now Schwann has shown. . . . It

results from Schwann's investigation. . . . Schwann's discoveries are to be ranked among the most important steps by which the science of physiology has ever been advanced.'

According to Schwann! A pleasing phrase which told him that he had achieved scientific fame: for was he not immortalized in a German text-book?

It was at this time that Schwann announced that infusoria do not originate by spontaneous generation. He was one of those who uprooted the belief in *generatio equivoca* till it fell like phlogiston and the vitalistic theory into those retired fields that are traversed only by the historical student of science.

The Greeks admitted that every primatic mammal had a father and a mother, but they thought the lower animals could arise *de novo*. Anaximander believed that the stimulating influence of moisture brought animals into existence, and Aristotle himself wrote that 'sometimes animals are formed in putrefying soil, sometimes in plants, and sometimes in the fluids of other animals.'

The Romans were no wiser, and in a striking passage of the *Georgics* Virgil describes the abiogenesis of bees, while the same thought is expressed in a couplet by Ovid:

Hide in a hollow pit a slaughtered steer,
Bees from his putrid bowels will appear.

Of course during the thousand years of insanity known as the Middle Ages such notions were universally accepted, and even Van Helmont published directions for the artificial production of mice. Such is the tenacity of error, that when Sir Thomas Browne said he doubted if mice could really come from a soiled shirt, or be bred by putrefaction, Alexander Ross angrily exclaimed, 'To question this is to question reason, sense and experience. If he doubts of this let him go to Egypt, and there he will find the fields swarming with mice, begot of the mud of the Nylus, to the great calamity of the inhabitants.'

The first man who shed light on the problem of equivocal generation was the seventeenth century physician-poet, Francesco Redi, who came to the conclusion that the maggots found in decaying meat were not produced spontaneously by the meat, but had been deposited there by flies. His proof consisted in covering meat with a fine gauze, thru which the putrescent odor escaped: the flies buzzed around it, but as the meshes were too small to permit their eggs to fall thru, no maggots were generated in the meat, but were hatched on the gauze.

A few years later a new door was opened in biology when the glorious Dutchman Leeuwenh  k looked thru a microscope and discovered bacteria. Thereafter, as far as most scientists were concerned, the debate about the origin of life resolved itself down to this point: Can the lowest forms of life be produced abiogenetically? Even to-day can be found country-people who believe in showers of frogs, and that horse-hairs kept in water turn into eels.

A liquid was heated to the boiling-point to destroy all living organisms, and the tube was sealed to prevent contamination from the outside air. As a rule these solutions remained sterile, but sometimes micro  rganisms were found in them. 'This proves,' claimed the abiogenists, 'the occurrence of spontaneous generation.' 'No,' said the biogenists, 'it proves only the imperfect sterilization of the fluid, or improper exclusion of germ-laden dust.'

All along the line the victory had been in favor of the doctrine that living things are produced only from antecedent living things. But when oxygen was discovered, and it was shown that this gas is essential to all forms of life, the question was asked: Was not Spallanzani's failure to find life in his infusions due to the fact that he heated his tightly-closed flasks till the oxygen lost its vital property?

It therefore became necessary to test the problem from the oxygen standpoint. In 1836 and 1837 Franz Schulze and Theodor Schwann devised experiments by which the air of the



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atmosphere that entered the flasks was compelled to pass either thru strong sulphuric acid or thru highly heated tubes. The oxygen of the atmosphere was not injured, but the germs were, and no life appeared in the cultures. Again the result was wholly in favor of biogenesis.

In 1854 a further blow was given to the doctrine of spontaneous generation by the discovery of Schroeder and van Dusch that 'if the mouth of the flask containing putrescible fluid was protected by a plug of cotton-wool thru which an abundance of air could freely enter and exit, but by which it would be filtered, no life appeared in the contents.'

In 1859, however, the entire question was again befogged and unsettled by Pouchet's emotional book. But then followed the classic experiments of Pasteur and Tyndall, and the theory of spontaneous generation was relegated to the ample museum of abandoned beliefs. This was one of Pasteur's greatest triumphs, and when the plaudits of the scientific world were ringing in his ears, he remembered that Schwann's experiments on fermentation had been of value to him and he sent the German a letter of gratitude.

But altho Pasteur proved beyond the possibility of doubt that when the infusion is sufficiently boiled and the air chemically purified no organism makes its appearance, it must be emphasized — as it is often forgotten — that his demonstration has not in any manner affected the question of the origin of organic matter. Pasteur showed that under certain artificial conditions life is not produced, but does this shed any light on the genesis of the earliest organism?

We watch an ameba and we say that this is the simplest form of life, but how did the first ameba arise? We no longer believe in gaps and leaps; in the long chain of nature there is no missing link. It is less than a century since the first organic compound was prepared artificially on a laboratory-desk. Schwann's work on muscular force and Du Bois Reymond's and Helmholtz's elaborate experimentation with animal electricity further helped to demolish the vitalistic hy-

pothesis, and we are continually adding planks that will eventually bridge the gulf between the organic and the inorganic. Daily the chasm that separates the living from the dead is growing narrower — we are filling it in with facts which tend to prove that organic matter evolved from inorganic.

When Butler Burke enclosed sterilized beef tea in a tube and allowed the emanations of radium salts to attack it, in a few hours, within the closed tube, specks appeared and grew and subdivided as if they were bacilli. Yet these specks were not living things; they were inorganic particles, but the radium had quickened the dead matter till it acted like the lowest organisms do. Perhaps it is time to change a few of our definitions.

Much as Darwinism has explained, it made no attempt to solve the problem of the first appearance of life on earth. But certainly we are not to assume a special creative act for the first organism: we must apply the doctrine of evolution here as everywhere. A complex organism developed from the cell, and the first cell developed from a substance simpler than a cell, the non-nucleated particles of plasm called the monera. And this first gelatinous mass, the simplest of all living matter — where did that come from? Ah, here is the essence of the question of the origin of life, but we shall not shirk it. We who are young, let us be as brave as the old Haeckel: the monera, as the lowest form of organic life, must have evolved from inorganic carbon-compounds, and thus in the broad sense we must believe in life which originated without antecedent life, and accept the hypothesis of spontaneous generation.

Yet we confess it is with an uncertain voice that we utter these words. The trouble is that we cannot write the chemical formula of a protein. The white of egg consists of carbon, hydrogen, nitrogen, oxygen and sulphur. If we could only take these five elements and mix them in our beakers or heat them in our crucibles or freeze them in our ammonia

tanks till they albuminized, man would become the possessor of the secret of secrets. This is the crux of all biologic problems: to create a bit of protoplasm. A chemist can make butter: when the biologist learns to lay an egg he will have solved the problem of life.

One of the last topics which Müller discusses in his *Physiology* is Schwann's cellular theory. But here it is necessary to introduce another personage — Schwann's friend, Matthias Jacob Schleiden.

Love between the sexes is considered the most interesting phenomenon that occurs on this planet, but in reality the matter is so simple that we can produce love by experimentation: Put a man and a woman on a moonlit beach together, and after they have listened to sad sea waves for an hour they will be in love. Love is a matter of opportunity. Think how often the boarder who is received into the homes of the poor to help pay the rent, causes domestic difficulties. Many a love-affair has been nipped in the bud because one of the parties moved half a mile away. The physical instinct, which is usually the basis and the reason for sex-love, seems to flourish only when nourished by propinquity. Not absence, but calling on her five nights a week, makes the heart grow fonder.

Altho supposed to be much tamer, friendship is more complex than love, and it is easier to understand love-matches than some friendships. Why did a pretty servant-girl attract the great Goethe? The answer is obvious enough,—because she was pretty—but who shall explain how it was possible for the large free-hearted Swinburne to have lived for years under the same roof with the priggish Mr Watt's-Dunton?

Certainly there was nothing mutual in the temperaments of Schleiden and Schwann. Schwann was colorless and characterless, but Schleiden had personality plus. Schwann was a pigeon, Schleiden a storm-petrel. No provocation could lure Schwann into a controversy, while Schleiden counted that day lost in which he had not argued. Schwann was pious,

while Schleiden openly proclaimed his disbelief in religion. Schwann was gentle and passive, a negative man; bold and fiery was Schleiden, a positive force.

On reaching the age of twenty, Schleiden saw it was time for him to do something, and he entered the university of Heidelberg to study jurisprudence. He graduated, and was willing to practice law, but altho the courts were full of plaintiffs and defendants, and Hans did trespass *ab initio* on the property of Fritz, and A forgot the contract that he made with B, and there was litigation between grantor and grantee, and the appellants swore to sue the appellees, and man loved not his neighbor, but loved his neighbor's wife, and busy attorneys spoke much of *prima facie* and of *ex debito justitiæ* and *damnum absque injuria*,—yet no clients came with cash to Counselor Schleiden. The business did not pay, Schleiden struggled for a time, then grew discouraged, and as he did not possess the judicial mind — never having been elevated to the bench — he attempted suicide. The action was both illegal and unsuccessful.

Schleiden then told his father that he had decided to study science, and his father, who was a physicist, encouraged him. So at the age of twenty-seven Schleiden arrived at Göttingen to begin a new career. This was in 1831, a few years before the famous seven professors were expelled, and the university was in a healthy condition. From Göttingen Schleiden came to Berlin where he plunged into botanical studies with all the ardor of his passionate nature. 'With his interest in botany,' says Wilhelm Bölsche, 'a new life began, and he worked with the energy of one raised from the dead.'

One day Schleiden and Schwann were dining together, discussing their researches. 'I have come to the conclusion,' remarked Schleiden, 'that the nucleus plays the chief part in the development of vegetable cells.'

Someone entered the restaurant, and the friends looked up for a moment. Not far from them three young men were

standing in front of mugs filled brimful with beer. At a given signal they raised the steins from the table, and drank with astonishing speed; the youngest finished first, brought his empty jug back on the table with a triumphant bang, and received the congratulations due to a champion.

‘Manifestly,’ resumed Schleiden, ‘the discovery of the nucleus was a great piece of work — it will yield tremendous results. To the health of Robert Brown! Really, I think I can trace back every plant embryo to a single nucleated cell.’

‘What you say,’ said Schwann, ‘reminds me that I have seen a similar organ in the cells of the dorsal cord upon which Professor Müller has put me to work. Besides, in the vertebrate notochord Müller has pointed out the existence of cells resembling those of the plant.’

‘Let me see these cells,’ said Schleiden. They hastened to the laboratory, and looking thru the microscope the eager eye of Schleiden saw that the nuclei of the chorda dorsalis were similar to the nuclei of vegetable tissue. ‘Identical,’ exclaimed Schleiden.

‘Then,’ mused Schwann, ‘it must follow in consequence of this identity that your conception must be extended also to the animal world. This means that the cell is the unit of all organic structure.’

In this manner did modern biology begin. What the molecule is to the chemist, the cell is to the biologist. Schleiden, the real father of the cell doctrine, wrote a short paper on the subject — *Ueber Phytogenesis* — sent it to Müller’s *Archiv*, and then wandered off into other fields.

Schwann, with his characteristic patience, sat down and began to test nails, feathers, enamels, and all organic tissues he could think of, found them all to be of cellular origin, and then wrote his elaborate treatise, *Microscopical Researches into the Accordance in the Structure and Growth of Plants and Animals*. It was a work that ‘set the crown of immortality upon an unwrinkled forehead.’ Here for the first time we find the now familiar term, cell theory: ‘The development

of the proposition that there exists one general principle for the formation of all organic productions, and that this principle is the formation of cells, as well as the conclusions which may be drawn from this proposition, may be comprised under the term cell theory.'

There had been vague foreshadowings of this theory in former centuries — everything intellectual germinated in the infinite brain of Aristotle. From the Greek we must skip to the Englishmen Hooke and Grew who drew cells, and to Malpighi and Leeuwenhoek who sketched the microscopic structure of plants — tho neither of these naturalists had any idea of the importance or the universality of the cell. Kaspar Wolff came much nearer to the truth, while Lorenz Oken was hot on the trail when he wrote that 'animals and plants are thruout nothing else than manifoldly divided or repeated vesicles, as I shall prove anatomically at the proper time,' but the proper time never came for him, for the brilliant transcendentalist, tho the most lucky of guessers and a dreamer of the highest rank, seldom cared to furnish proof for his statements.

In truth Schleiden and Schwann received scant aid from their forerunners, and subsequent investigators have had occasion to modify considerable of the founder's work. For instance, Schleiden thought he had seen cells arise *de novo*, and not only by the division of pre-existing cells, and strangely enough, Schwann who had done effective work against spontaneous generation, followed him in his misconception. It remained for Virchow to announce *omnis cellula e cellula*.

Some of Schleiden's and Schwann's mistakes were inherited from the seventeenth century. Thus, in 1665, Robert Hooke, whom we have mentioned above, cut a thin section of cork with his penknife, looked at it thru his microscope, and described what he saw as made up of 'little boxes or cells distinguished from each other,' for in cork the cell-wall is the most prominent element. After the publication of his *Micrographia*, showing the earliest known pictures of cells, it was

believed that the cell wall was more important than the cell contents. We now know that the cell wall or limiting membrane, tho conspicuous in vegetable tissue, is non-essential, and is present in but few animal cells.

It is true that within the cell wall Schleiden had seen a substance which he simply called gum and forgot. But a host of workers—Dujardin, Purkinje, von Mohl, Nageli, Ferdinand Cohn, DeBary, Virchow—kept their eyes screwed on Schleiden's gum till they pronounced it the essential substance of all living cells. Then came one whose vision saw the correlation of this vast biologic leaven, and Max Schultze joined the cell doctrine and the protoplasm doctrine into one harmonious whole, and each fact fell into its place like the elements in Mendeleyeff's Periodic System. A few years later, on a Sabbath evening, Huxley proclaimed to a popular audience that life has a physical basis, and then proceeded to lecture on protoplasm.

So we see how far others advanced beyond Schleiden and Schwann, but the glory of pioneer work is theirs.

The time must have been ripe for the cell-theory, for instead of the calumny which is the usual lot of the innovator, both Schleiden and Schwann reaped rewards.

The great Catholic University of Louvain—which had been swept away by the French Revolution, and had just been re-established—needed a professor of anatomy, and Theodor Schwann, twenty-nine years of age, was asked to fill the chair.

Jena likewise needed another member on its teaching staff, an adjunct professor of botany, and the position—it is believed on Humboldt's recommendation—was offered to Matthias Jacob Schleiden.

For ten years Schwann taught at Louvain, and for more than thrice ten he was professor at Liege. Breslau asked for him in 1852, Würzburg and Munich wanted him in 1854, and the following year he was invited by Giessen. But his Fatherland never got him back. For the rest of his days Schwann lectured in a strange tongue. The Catholic atmos-

phere of Belgium suited him better than the rationalistic spirit which was invading the German universities. He came to Germany only during the Christmas vacations to visit his parents and brothers and sisters in the neighborhood of Cologne, for evidently Schwann did not accept Coleridge's estimate of his birthplace:

In Köln, a town of monks and bones,
And pavements fang'd with murderous stones,
And rags and hags and hideous wenches—
I counted two-and-seventy stenchs,
All well-defined and several stinks!
Ye nymphs that reign o'er sewers and sinks!
The river Rhine, it is well-known,
Doth wash your city of Cologne;
But tell me, nymphs! what power divine
Shall henceforth wash the river Rhine?

Schwann arrived in Belgium, young and famous. Over forty years of work yet remained to him. These forty years were the Golden Age of Science in which the entire scientific world was recast — vastly improved. A thousand hypotheses were overthrown, musty theories were hauled into the light of day and re-examined, discovery crowded thick upon discovery, the world was flooded with fact, and Truth rose glorious as never before. Biology entered every home,—and environment, adaptation, atavism, hereditary transmission, struggle for existence, and survival of the fittest, ceased to be technical terms and became colloquisms.

What did Schwann accomplish during all these fruitful years? Well, he published a monograph on bile, but nothing else. He went to an honored grave in his seventies, but over his coffin waved the laurels he had earned in his twenties. Age added not a single leaf to the crown of immortality which he won in his youth. Schwann was not an original thinker; he could work only when he received the stimulus from a strong man like Müller or Schleiden. It is a pity that he feared the atheism of the German students. Had he ac-



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cepted the call to Würzburg, for instance, Schwann could not have witnessed von Kölliker making a new discovery in histology every year without being inspired to emulate him. However, there is nothing peculiar about Schwann's case: many a young man has done brilliant work while occupying an obscure post; then they make him a Hofrat or a Geheimrat, and he does nothing — except discover that it is easier to repeat last year's lectures than prepare new ones.

But peace is the great narcotic that is apt to lure us all into a life of nothingness. And yet Schwann's long uneventful existence in Belgium was disturbed at least once:

Louise Lateau, the pious daughter of a Belgian miner, was so very ill that she received the last sacrament. But she did not die; she fell into an extasy — from which only Bishop Dumont of Tournay could awaken her — and her body became marked with the print of her Savior's bruises. Often for hours she had contemplated the crucifixion, and now on her own body appeared the injuries that had been inflicted upon Christ. Where the crown of thorns had been set, where the nails had been hammered, and where the Roman soldier had thrust in a spear, Louise Lateau was sorely wounded. This case of stigmatization excited considerable interest, a committee was appointed to investigate whether her wounds were due to natural or supernatural causes, and Theodor Schwann was asked to be a member.

To one not connected with the Catholic Church the case had no special significance and offered no insuperable difficulties. All that was necessary was to observe the girl, question her, study her condition, and write a report. But stigmatization is one of the accepted miracles of Catholicism, and for a son of the Mother Church to disbelieve in it was like denying the efficacy of transubstantiation or the possibility of the resurrection. It was all very well for some German materialist to say that stigmatic neuropathy was a pathological condition of occasional occurrence, explainable by physical and mental conditions. It was easy enough for others to point

out the analogy between vicarious menstruation and hemorrhagic exudation, and to talk about hystero-epileptic conditions and the effects of automatic attention upon the body; it was natural for a scoffer to say that many cases of stigmatization had been found to be fraudulent, and that Theresa Städele, Rosa Tamisier, Angela Hupe, Sabina Schäfer and others had been imprisoned for their impositions; and who could help it if an infidel claimed that the crown of thorns on Rita of Cascia's forehead was simply a circle of pimples due to smallpox? It was not difficult for the cynical Dr H. Böens to spy upon this Louise Lateau and to announce that she frequently rubs and scratches with her nails and with a rough cloth, especially during the night, the places where the blood flows, and that she keeps up on these spots, even mechanically during sleep, pressure with her fingers, so as to maintain a condition of local congestion — he was no better than Professor Bodde who had examined Anna Emmerich's wound-prints, and pronounced the blood-marks due to *sanguis draconis*. But had not popes anathematized those who failed to believe that stigmatization was an evidence of God's favor towards his saints?

The Church indicated nearly a hundred instances in which miraculous stigmatization had occurred. This divine chastisement was first inflicted in 1224 upon St Francis of Assisi, who had retired to a hermit's hut at Mt Alverna in the Apennines. In a vision the saint saw a seraph whose face burned with fire and radiated light in every direction, and between whose wings appeared an image of the Crucified One. When Francis awoke he was stigmatized in imitation of Christ, and St Clara could not pull out the nails.

Because of this event the Franciscans soon overshadowed the older order of St Dominic, but in the next century God saved the reputation of the Dominicans, for a bloody sweat bathed St Catherine of Siena, the Dominican sister, then the coronation with thorns appeared, and finally the lance-wounds.

Since that time stigmatization occurred more frequently —

God having become accustomed to the work — and the Church pointed to St Leo whose body at birth was marked all over with red crosses due to the intense meditation of his mother on the passion of Christ, and a sign that the child himself would carry the cross to his life's end. There was Maria von Morl whose stigmata in the hands, feet and side were witnessed by over 40,000 persons. St Gertrude of Ostend during Holy Week felt five punctures, two in the hands, two in the feet, and one in the side; from these stigmata blood flowed seven times a day at the seven canonical hours, but when the crowds came to see the miracle, Gertrude feared she might grow vain, and prayed that the flux of blood might cease, and altho her desire was granted, the marks of the Passion remained till death. St Catherine of Ricci was known as the virgin bride of Christ, for the savior himself placed upon her finger an engagement ring, and marked her body with the sacred stigmata, since which time, during Passion week, she experienced all the torments of the Redeemer. A similar case was that of St Lidwina: angels came to her, and not only did she converse with them, but even called them by name; she was also granted personal interviews with her celestial spouse, who on one occasion impressed on her body the marks of his suffering, but to avoid vanity she entreated him to render these stigmata invisible to others, a favor which was accorded to her.

And these cases, which we have reported in almost the words used by the ecclesiastics, were but a few out of many. How then could a true Catholic like Schwann deny them? Had not the Bulls of Pope Gregory IX expressly commanded his subjects to accept them as a proof of divine intervention in human affairs? Schwann's decision was a foregone conclusion, and hasty clerical papers, without consulting him, announced that he regarded Louise Lateau's wounds as miraculous.

But the statement was premature. All his days Schwann had dwelt in the shadow of the house of truth. While yet

a child he had consecrated his life to her service; his prayer had been heard, and Science laid her hand upon him. In her name he had been admitted to holy places: clothed in her garments he had clasped the hand of Johannes Müller, and for five years he dwelt in the master's temple.

It was time for him to draw up his report; before him lay the blank paper. Out of the ink-horn rose the ghost of Lolyola and beckoned to him: 'You are one of us — deny us not!' Now Schwann knew there was no miracle connected with the wounds of Louise Lateau. Schwann wrote, but over his pages fell the spirit of science. The man was true to his youthful vow.

Upon the publication of Schwann's report the clerical press was equally astonished and enraged, and a bucketful of printer's ink was poured upon the amiable old man. Harsh epithets were coined in editorial offices, but Theodor Schwann made no reply. For a lesser offense the aged Galileo had been forced to recant on his knees, and men had been marched to the stake, but the nineteenth century was better than the sixteenth: it was the Age of Biology, and in a Catholic institution Schwann retained his professorship. Great Galileo was right in more ways than one: *Eppur si muove!*

In the meanwhile we have left Professor Schleiden at Jena — the most liberal school in Germany. It is true it couldn't tolerate the metaphysical atheism of the moral Fichte, but this was before Wolfgang von Goethe had time to make the little university eager for new ideas. When Schleiden began to teach botany, the science was overrun by obsolete Linnaean survivors who thought the only occupation of the naturalist was to clip, collect and catalog.

In the midst of their pedantic rules, jauntily upsetting their archaic laws, Schleiden flung his *Principles of Scientific Botany*, in which, for the first time, botany was treated according to the inductive method. The work was dedicated to Humboldt, no doubt as a personal tribute, but also to indicate that the author considered botany related to the other

sciences. The preface begins gently thus: 'Whoever thinks he can learn botany in this book may as well put it aside at once without reading it, for botany cannot be learned from books.' Those of us who studied phyllotaxy in Asa Gray's Botanical Text-Book, and recall with a shudder its hopelessly monotonous pages, may well regret that Schleiden's book has gone out of use. We admit it sometimes digressed and sometimes indulged in personalities, but that only made the calyx and the corolla more interesting. Schleiden was certainly the most tempestuous plant that grew in the botanical garden.

The foremost historian of botany has reviewed *The Principles of Scientific Botany* in words too significant to be omitted: 'Schleiden's book,' writes Julius von Sachs, 'was the first of its kind that supplied the student with really good figures based on careful observations. With all its many and obvious defects it had one merit which cannot be rated too highly; its appearance at once put botany on the footing of a natural science in the modern sense of the word, and placed it upon a higher platform, extending its horizon by raising its point of view. The difference between this and all other previous text-books is the difference between day and night; in the one an indolent carelessness and an absence of ideas; in the other, a fulness of life and thought, calculated to influence young minds all the more, because it was in many respects incomplete and still in a state of fermentation. On every page of this remarkable work, by the side of facts really worth knowing, the student found interesting reflections, a lively and generally coarse polemic, and praise and blame of others. It was not a book to be studied quietly and comfortably, but one that excited the reader everywhere to take a side for or against, and to seek for further instruction.'

Schleiden followed this work by another equally successful — *The Plant and its Life*. Its object was to popularize botany and to show that the botanist is no longer merely a dealer in barbarous Latin names, a man who gathers flowers, names

them, dries them, and wraps them up in paper, and all of whose wisdom consists in determining and classifying the hay which he has collected with great pains.

This volume might well be called the poetry of botany. It is a lyric of leaves, an epic of oaken esplanades. As we turn its pages we hear the sap stir in the young trees, and the old branches on the ground crackle under our feet; we inhale the sweet jessamine, and the willow shakes its pollen in our faces.

Only a poet could have written this book and Schleiden was a poet: he even wrote verses under a pseudonym. Contrary to a general belief, many scientists possess an artistic streak. Tyndall was the troubadour of the Alps; Ludwig Buchner, the arch-materialist, wrote poetry that deserves to live; if Dujardin's miniatures had sold, he would never have concerned himself with sarcodæ; by the side of Max Schultze's microscope lay his violin; August Weismann too, when he could no longer gaze down the ocular, solaced himself with music; Avenbrugger wrote an opera, and Claude Bernard a drama; and the investigator of the Radiolaria confessed, 'In Sicily I was nearly thrown out of my line and made a landscape-painter.' It is true there are many plodders in the universities and laboratories who scorn what they call imagination, and pride themselves on being exact scientists; these are the sort who modify someone's reagent, or succeed in improving a separatory funnel for quantitative extraction, but they seldom do big work. There are conspicuous exceptions, however, like Cavendish in chemistry and Gegenbaur in anatomy.

The Plant and its Life appeared in England, translated by the botanist Arthur Henfrey. In 1853 the work was published in the United States, but not in its entirety, as some of Schleiden's heresies were considered too shocking to meet the innocent eyes of the God-fearing Americans. The editor of the edition, Alphonso Wood, calmly announced, 'We have taken the liberty to suppress passages, which were liable to be construed as irreverent.' It has long been known that few masterpieces of European literature appear in America in

their full virility, but it may be news to some that even scientific writings are emasculated before being served to our dainty mental palates. We wonder if the time will ever come when the prudes and the hypocrites will be prevented from tampering with the works of better men.

The charm of this volume made many converts for botany. It is related of one bright German lad that three books especially influenced his formative years — excluding the works of Goethe. They were Humboldt's *Aspects of Nature*, Darwin's *Naturalist's Voyage Round the World*, and Schleiden's *The Plant and its Life*. While still a school-boy at Merseburg the ardent reader dreamed of studying botany under Schleiden at Jena. Indeed, having an indulgent father, he was permitted to visit the land of his desire. In vivid words he has himself told how after reverently admiring the Goethe-room in the castle of Dornburg, he wandered, on a hot July day, over the shady meadows to Jena, singing lustily with his gay comrades. As he entered the venerable old market-place he found a troop of lively students in front of the Burgkeller, with colored caps and long pipes, singing, and drinking the famous Litchtenhain beer from wooden tankards. It made a great impression on him and as he took a tankard with them he made up his mind that he would some day be one of them.

Two years later the examinations were passed and he engaged rooms at Jena. But before the term began he determined to find a specimen of *Scilla bifolia* and show it to Schleiden. The day was cold, the meadows were wet, the plant was rare, and the collector was imprudent. Hours passed before he discovered the squill, but he satisfied the collector's mania, and he was happy. That night he was attacked by a chill, he felt nauseous, there was a painful stiffness in his joints — it was a beautiful case of rheumatism. The student had to return to his parents at Berlin, and Schleiden began his classes without Ernst Haeckel.

While pursuing his botanical studies Schleiden often had occasion to delve into the historical portion of his subject,

and was surprised at the prominent rôle which the Jews played in the growth of science; going deeper into the matter his surprise turned into admiration and he expressed the results of his researches in a booklet on *Science among the Jews before and during the Middle Ages*, which was followed by his *Romance of Jewish Martyrology*.

In the first-named production he lambastes the Christians with downright vigor and extols the Hebrews as paragons of virtue and wisdom. He is right in declaiming against the barrenness of monastic medicine and eulogizing the superior attainments of the countrymen of Maimonides, tho the passion displayed may cause some to imagine that he carried the odor of the law-court into the halls of science. 'All Europe,' writes Schleiden, 'had its Middle Ages, a period of barbarism, of intellectual and moral decay, as deplorable as any that can be conceived. Only the Jews formed an exception. Despite dispersion and oppression, which often robbed them of the very right to live, they continued to develop their intellectual life, without interruption, to the end of the Middle Ages, preserving and transmitting to other nations the bases of morality and of mental life. Like all nobly endowed natures, they stumbled now and then during happy moments, when the burden of existence was lightened, but every reverse of fortune, every affliction, however bitter and severe, only serve to ennoble them, to quicken them to higher mental and moral effort.'

Schleiden's name will ever remain illustrious as a reformer of botany, but versatile men are apt to be impatient, and Schleiden had a habit of reaching conclusions on insufficient evidence. His opponents were not slow in pointing out the misstatements of this opinionated botanist. At first Schleiden fought with both fists in defense of his assertions, but more than once he was defeated by proof. Schleiden was impressionable: he became disgusted with himself and lost interest in botany. When the third edition of the *Principles of Scientific Botany* appeared, it contained no revisions by the author

— Schleiden would not bother with it. Quite different was the careful histologist Kölliker who enlarged his *Handbuch der Gewebelehre* after he had passed the age of seventy-five. Later *The Journal of Scientific Botany* ceased publication, for Schleiden refused to edit it any longer. Finally, in 1862, Schleiden resigned his professorship.

He went to Dresden, and dallied with anthropology. But Schleiden had a reputation, and Dorpat made this offer: the chair of botany and anthropology, with the rank of a Russian councilor of state. Schleiden accepted, and thus the Livonian university acquired another attraction besides Fraunhofer's refracting telescope. But Schleiden interspersed his lectures with sundry uncomplimentary remarks regarding the dominant theology, and soon he was invited to allow the great telescope to shine alone in its glory.

He returned to Dresden — the German Florence, as Herder called it — and immersed himself in philosophy; from Saxony's capital he came to Frankfort, and must have been reminded of his former panegyrics when he passed the famous Ghetto — the same *Judengasse* where the beautiful young Goethe had lingered with curiosity and received the smiles of Jewish maidens. For a time he was at fashionable Wiesbaden, but returned to Frankfort-on-the-Main where his last days were spent. During the summer of 1881, at the age of seventy-seven, the unique Schleiden passed away. During the Christmas season of the following year, while visiting his relatives, Schwann received the fatal stroke which carried him off, aged seventy-two.

Three-quarters of a century have passed since the inauguration of the cell-theory, and the names of Schleiden and Schwann have grown historic.

In that incompleted but immortal introduction which was still in the making when its author perished of a fever at Damascus, crying, 'My book, my book, will never be finished!' — we find a foot-note to this effect: 'There is, however, now reason to think, that both animal and vegetable tissues are,

in all their varieties, referable to a cellular origin. This great view, which M. Schwann has principally worked out, will, if fully established, be the largest generalization we possess respecting the organic world, and it would be difficult to overrate its value.'

Buckle's prophecy has been fulfilled: to-day we cannot deal with heredity, reproduction, embryonic development, repair, regeneration, anabolism, catabolism, motion, locomotion, or questions of stimuli, without going back to the cell.

'I believe without hesitation,' said Oskar Hertwig, addressing the Congress of Scientists at Aachen in 1900, 'that I must indicate as one of the greatest acquisitions of biology during the nineteenth century the discovery that plants and animals are built up of cells, of innumerable elementary organisms.'

In the *Allgemeine Physiologie* that Max Verworn of Jena published in 1909 are written these words: 'It is to the cell that the study of every bodily function sooner or later drives us. In the muscle cell lies the problem of muscular contraction and of the heart beat; in the gland cell reside the causes of secretion; in the epithelial cell, in the white blood corpuscle, lies the problem of the absorption of food, and the secrets of the mind are hidden in the ganglion cell.'

Had it not been for the cell-theory Darwinism might have gone begging in its day, but when men saw that all living things, from a blade of grass up to an Asiatic elephant, arose from a cell and consisted of cells, it was easier to believe that such universal resemblances were due to a common descent.

At least a dozen different men have been hailed as the father of modern biology, and as it is a wise science that knows its own father, we will not examine the parentage too closely. Yet, in view of the fact that to-day our text-books in histology, embryology, physiology, pathology, and physiological chemistry open with a study of the cell, would we be far wrong if we claimed the honored title for Schleiden and for Schwann?

(1809-1882)

DARWIN, SAINT OF SCIENCE

DARWIN, SAINT OF SCIENCE

[Written for the Centenary Anniversary of Darwin's Birth]

When the carriage drew up before Darwin's house, with its ivy and its shadowy elms, the great scientist stepped out of the shade of the creeper-covered porch to meet me. He had a tall and venerable appearance, with the broad shoulders of an Atlas that bore a world of thought: a Jove-like forehead, as we see in Goethe, with a lofty and broad vault, deeply furrowed by the plough of intellectual work. The tender and friendly eyes were overshadowed by the great roof of the prominent brows. The gentle mouth was framed in a long, silvery-white beard. The noble expression of the whole face, the easy and soft voice, the slow and careful pronunciation, the natural and simple tenor of his conversation, took my heart by storm in the first hour that we talked together, just as his great work had taken my intelligence by storm at the first reading. I seemed to have before me a venerable sage of ancient Greece, a Socrates or an Aristotle.

—HAECKEL.

EONS ago, when the Megatherium and the Dinatherium fought, and the huge tusks of the Mastodon and the Mammoth clashed, and gigantic reptiles crawled on their bellies over the face of the earth, and the yell and howl of Cretaceous creatures resounded thru the primitive jungle,—the world was savage.

Later, an ape-like being grasped a hanging branch, and raised itself to an upright position, and peered into the primeval forest. This was the immediate ancestor of Man,—but the world was savage still.

In the Tertiary epoch, for the first time appeared an animal that walked erect, and used a tool, and wore a garment. This was lordly Man himself,—but the world was savage still.

Since that distant day, species have evolved into different forms; sea has turned into land and earth become water; mountains have crumbled into dust, and the lowest valleys have become the highest hills; customs have prevailed and

perished; races have lived and died; religions have come and gone; empires have risen and fallen; one system has replaced another, which in its turn has given way to a later, — and now we are veneered with culture and varnished with civilization, but, scratch us, and you will find us savage still. The lower instincts of the lower beasts survive in us. We, too, worship the primitive law of force. We do not bite with the pointed tooth, nor rend asunder with sharpened claw, but our navies ride at anchor, and at a moment's notice a million murderous guns will belch forth the stuff that makes a child an orphan. We, too, are hunting and being hunted in a World of War.

But Nature, it is you who are the supreme warrior. Destruction is your delight. The entire earth is your graveyard. Every grain of soil is stained with blood, and every blade that grows, every flower that bows its head before the breeze, is a monument to the dead that forever rest beneath. Where is the feathered songster of the forest that has not feasted on its prey? Alas, the same lovely throats which from their leafy dwellings fill the great woods with harmony, are red with the blood of weaker victims. Then they sit and shiver at the thought of intruders more powerful than themselves.

Fear, fear, fear,—everywhere is fear. Nothing is safe. All is murder. Nature is the eternal veteran, all are her enemies, and she never accepts the flag of truce. She makes a type and then she kills it. For the individual she has not the slightest regard. She cares nothing for the life which comes continually from her teeming womb.

Nature, thy mandate is chiseled on the rocks, it is echoed from the swamps to the snows, it resounds from the marshes to the mountains, the prairies know it, and the pampas tell it; it is writ across the sky, and our planet moans beneath the stern decree: flesh shall feed on flesh, and life must take life.

You destroy what you create, O Blunderer! Nature,

where is thy justification? In the beginning, this earth swept thru space, formless and void. Darkness was upon its face, — except when the lightnings flashed and the volcanoes glowed. But the black veil lifted, the golden sun poured its warming rays on the desolate globe, and lo! — Mother Earth was pregnant. A tiny speck lay in the primitive waters, and this was life. And Nature watched our ultimate ancestor, and from that time on, her heavy hand has smitten and slaughtered.

What is it all for? Nature, is this the secret: *that thou wipest out a type to bring a higher in?* Show us then, the Perfect Man. Thou hast worked long enough for him. Thru countless epochs the process has gone on. Show us, Nature, the best you have produced. We wish to see your favorite and pride.

And if you show to us a savant whose wisdom was vast, but who fawned at the feet of degenerate aristocracy, we want him not. And if you show to us a writer whose style was sweet, but who bartered his brain for gold, we want him not. And if you show to us a scientist who studied the laws of the universe, but paid toll to theologic superstitions, we want him not. And if you show to us a bishop who preached in favor of the poor, but evicted his tenants on a wintry day, we want him not. And if you show to us a poet who vehemently sang of love, but deserted his trusting wife, we want him not. And if you show to us a philosopher who wrote on the responsibilities of parenthood, but neglected his little children, we want him not.

But Nature answers: What of him, my warmest lover, my humblest servant? What of the gentle hand that placed the radiant crown on the undecked brow of Truth? And Nature has redeemed herself. She may have blundered, and she surely has effaced, but she has evolved the Perfect Man. She has unfolded Darwin the Great and Good,

Charles Darwin was a naturalist. He investigated facts. He did his work so well that to-day no thoughtful man can

cast his net for specimens, or wander thru the depths of a tropical grove, or explore fossil remains in a geological deposit, or scrape the barnacles from a passing ship, or study the structure of a coral-reef, or survey a belt of sand-dunes, or scrutinize a monkey's expression, or question an aboriginee, or watch a crawling worm, or examine a pollen-grain, or look at a dung-rolling beetle, or dissect a curious stomach, or observe a plant under domestication, or witness an unusual hail-storm, or climb a granitic range, or view a glacier casting off its icebergs, or meditate upon the dawn of mankind or speculate on its future destiny, without recalling some careful and conscientious passage from the unassuming thinker who dressed in dusty gray, and lived in the village of Down.

The works of Darwin! Put all his books on a shelf, stand in front of them, O Mortal,—and think! Think how much love, how much wisdom, how much patience, how much learning, how much merit, how much modesty, how much greatness, how much goodness, went into the making of them. Here is the *Journal of Researches*, which has awakened the love of nature in many breasts, and induced more than one individual to travel from one end of the globe to the other. Here is the *Structure and Distribution of Coral Reefs*, an unsurpassed example of the scientific method. Here is *A Monograph of the Sub-class Cirripedia*, and this alone is sufficient upon which to found an immortal reputation. Here is the *Expression of the Emotions in Man and Animals*, which laid the broad foundations of the modern science of comparative psychology. Here is the *Formation of Vegetable Mould thru the Action of Worms*, which involves an experiment that occupied twenty-nine years, and thus serves as an inspiration to all who labor earnestly in the arduous fields of science. Here is the *Variation of Animals and Plants under Domestication*, one of the most valuable possessions in the mighty treasure-house of botany. Here is the *Descent*



DARWIN

of *Man*, which fully treats of selection in relation to sex. The scientist who saw all nature at strife, saw her also in moods of love. The nightingale sings, the turtle-dove coos, the katydid babbles, the pigeon nestles close, the cricket chirps in the amorous dusk, the widow-bird spreads its caudal plumes, the butterfly shakes its brilliant wings, the sea-scorpion swims to the spawning-bed, the crocodile splashes in the little lagoon, the black-cock dances in eager passion, the starling flies to its waiting mate, the turkey struts with distended wattles, the night-jar makes a booming noise, the wood-pecker strikes a sonorous branch, the bustard rises with hurried flapping, the bower-bird builds its courting-home, the peacock extends its gorgeous train, the pheasant displays its splendid frills, the eared-seal carries its willing bride, the musk-deer emits a pleasant odor, the lion tosses its jubate mane, the linnet distends its rosy breast, the draco glides thru the sweetened air,—all in spring-time, all for love. Look at this; here is the *Origin of Species*, the book that changed the world, by causing its intellectual channels to flow in different courses than it had hitherto followed. The works of Darwin! You stand before the accumulated knowledge of all the ages. A thousand discoveries are within these covers. Think how deep and often that noble brow has been contracted with thought. Is the topic too vast? Does its immensity balk the mind? Then think of this one theme: From a chattering ape of the forest, swinging from branch to branch by its prehensile tail, to the scientific Darwin in his studio, writing on the Geological Succession of Organic Beings!

At the beginning of the nineteenth century, the Father of Paleontology showed — by fossil remains — that a series of different animal species had succeeded each other in the various stages of the earth's existence. Naturally, the question arose: What caused the extinction of the older species, and what gave rise to the later ones? Linné and Cuvier and nearly all others solved this problem by the catastrophic theory.

They claimed that overwhelming periodic cataclysms swept over the globe, wiped out every living creature, and then entirely new beings were specially created. It was a series of wholesale destructions and wholesale re-buildings. The Architect of the Universe grew dissatisfied with his work, and, therefore, threw away his old blocks and commenced to build anew.

A few intellects were too clear to be entangled in these mythological meshes. Some were keen enough to see that species undergo modification, and that the existing forms of life are descended from pre-existing ones.

To Buffon belongs the high honor of first scientifically discussing the origin of species by development. But Buffon lived in the priest-pested age of Louis XV, when the Bastille cast its shadow on the brain of every thinker. And Buffon often thought of the chains that eat out the flesh, and the dungeons which the sun cannot find, and then he ended his arguments thus: 'But no; it is certain from revelation that every species was directly created by a separate fiat.' (Yet Galileo-like, he must have murmured, *Eppur Si Muove!*)

In the same land was born Lamarck, a genius cast in more daring mold, who openly proclaimed his conviction that all species, including man, were descended by modification from primordial forms.

Men began to recall that Kant, in his cosmical conception, had said something of development.

Then three stars brightened the scientific sky,—Goethe, Erasmus Darwin and Geoffroy St Hilaire.

Next came the American Dr Wells, who recognized the operation of the principle in the distribution of the human race.

Dean Herbert and Professor Graut saw a twinkle of the coming dawn.

A little later, Patrick Matthew, building far better than he knew, wrote a book on Naval Timber, the appendix of which contained a brief but complete account of the doctrine of natural selection!

Von Buch in the Canaries, and Wollaston in Madeira were coming to the conclusion that varieties may be gradually changed into species.

Every Sunday afternoon, in the spacious halls of his great museum, a German professor walked to and fro, his hands behind his back, buried in thought. A favorite pupil sat in the angle of the window, skilfully drawing the skulls of mammals, reptiles, amphibians and fishes. 'Master,' asked the boy, 'must not all these vertebrates, with their identity in internal skeleton, in spite of all their external differences, have come originally from a common form?' 'Ah,' answered Johannes Müller, as he looked at young Ernst Haeckel, 'if we only knew that! If ever you solve that riddle, you will have accomplished a supreme work.'

Lyell caught a glimpse of the truth. Oaken was re-studying Lamarck. Bates wandered thru the Brazilian forests, and on the gossamer wings of the tropical butterflies read the tale of evolution.

To Treviranus, Haldeman, Horner, d'Halloy, Owen, Freke, Naudin, Keyserling, Schaaffhausen, Baden-Powell, Isidore St Hilaire,—to these, nature whispered the same secret.

Lecoq the botanist, and Von Baer the zoologist, heard it. Wallace sat under the Malayan palm-trees, and the lazy breezes bore him a similar story. Spencer wrote on the theme and Huxley lectured.

The scientific atmosphere grew tense. Much thinking was done, but the theory of evolution remained in an unsatisfactory state. There were many scattered bricks, but no stately temple. The thoughtful ones worked by day and prayed by night, O curtain, that hidest the unknown, when wilt thou be drawn aside?

On November 24th, 1859, as if in answer to this cry, a light pierced the gloom, and the world has been illumined since.

That light was Darwin's *Origin of Species*.

A score and seven years ago, the body of Darwin,—borne by two dukes, two sirs and a belted earl—was laid at rest

in Westminster Abbey, next the ashes of the mighty Newton. A fitting honor, and yet a vain one, for when the altars and architraves of the great Abbey rock and reel, when its lighted and vaulted ambulatory becomes the abode of the bats, when its murals and mosaics are destroyed, when its twisted columns and its spiral bands totter in despair, when its effigies of angels and its monuments of royalties are obliterated, when the cloisters and the chapter-houses tumble in a heap, when its pointed towers and projecting transepts embrace the lowly dust, the illustrious and immortal name of Charles Darwin will still be a living force. Only when the race of man ceases to search for truth, can the lustre of that name grow dim.

One hundred years ago, Darwin was born. To-day the entire intellectual world salutes him with homage. Not with the roaring of guns, but with the throbbing of brains and beating of hearts. Of all the men who ever lived it is perhaps impossible to find another who was so world-famous and so modest. An Alexander conquers a few kingdoms from barbarian subjects, and henceforth considers himself a god. A Horace writes verses which gain admiration, and he follows this by another poem boasting that he has reared unto himself a monument more enduring than brass. But a Darwin wrests secret after secret from the breast of nature, he explains what was never explained before, and at the last he simply says: *Ignoramus, In Hoc Signo Laboremus*.

But in spite of his excessive gentleness he was absolutely independent, and when the cause of his beloved science was at stake, he could easily stand against all without flinching. His work was great, and so is his reward. Let anyone now think in a pre-Darwinian manner, and he becomes as much an anomaly as one who should seek for the magic stone that transmutes baser metals into gold. Within his own lifetime his name was turned into an adjective, and a thousand Darwinian writers were filling libraries with books on Darwinism.

Succeeding generations have continued the worthy and wel-

come task, and to-day on his centenary, his grave is the greenest in all the world. Tall men from the ends of the earth have garlanded him with wreaths that do not fade, and laurels that never die.

Among these glorious bay-trees I cast this little chaplet. It is small, and its merit scant, but every leaf of it was interwoven with veneration. It will not bloom like other coronals, tho it was love that brought it forth. Accept, accept it, O Saint of Science, for I too know thee as the wonder and the glory of the universe!



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